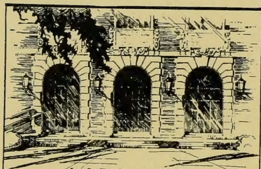

A HISTORY OF
THE COLLEGE OF ENGINEERING
OF THE
UNIVERSITY OF ILLINOIS
1868-1945

Part II

BY

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CHAPTER XIX

THE DIVISION OF CHEMICAL ENGINEERING

General.- Because much of the research work done by the Division of Chemical Engineering, or Division of Industrial Chemistry, as it was originally called, of the Department of Chemistry of the College of Liberal Arts and Sciences is directed and financed by the Engineering Experiment Station of the College of Engineering, some mention of this phase of its activities is included here in the following pages.

A. DEVELOPMENT OF LABORATORY FACILITIES

Coal Experimental Laboratories.- When the Engineering Experiment Station was established in 1903, or within a comparatively short time thereafter, investigations were under way by the division of Industrial Chemistry on the coking of coal at low temperatures, on the weathering and spontaneous combustion of coal, and on a study of occluded gases in coal of all types from the freshly-mined samples to old and weathered forms. The usual laboratory equipment, such as coal calorimeters and gas-analysis apparatus, was available for carrying on these tests. In order to conduct some of the experiments, particularly the work relating to the coking of coal and a study of the by-products, a special investigational plant was set up in the boiler room of the Boneyard Power Plant, where tests were made on samples of Illinois, Kentucky, and eastern coals. This equipment consisted of a grinder to prepare the coal, an oven that was rebuilt from time to time to provide different conditions, and a number of gas tanks, in addition to the calorimeters and chemical apparatus mentioned above.

Low-Pressure Laboratories.- Experimental work relating to the study of the embrittling action of water on boiler plate was begun at the University in 1912, and has been carried on almost continuously to the present time. In the early 1920's there was erected a small wooden structure between the street railway tracks and the Boneyard east of Goodwin Avenue which has been known as the low pressure Research Building. This laboratory was equipped with fifty units for

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making embrittlement tests of boiler-water samples and with a small high-pressure test boiler capable of generating steam at pressures up to 3,200 pounds a square inch and of superheating the steam it generates.

When the Abbott Power Plant was completed in 1940, a laboratory was fitted there so that tests pertaining to boiler feed-water could be run at steam pressures up to 350 pounds a square inch with steam supplied directly from the power-plant boilers. The apparatus is arranged for conducting experiments on the steam, boiler feedwater, and condensate return.

Facilities in the Noyes Laboratory, also used in the boiler feedwater tests, have included equipment for the chemical analysis of boiler-water samples, boiler-tube deposits or scale, etc.

Chemical-Engineering Unit Operations.- The main chemical laboratory is provided with apparatus to demonstrate the principles involved in such unit operations as evaporation, distillation, heat-transfer, flow of liquids, drying, filtration and separation, humidification and dehumidification, combustion, sedimentation, gas absorption and extraction, etc. The equipment includes pumps, meters, condensers, evaporators, vacuum and shelf dryers, fractioning columns for vacuum and pressure distillation, filter presses and centrifuges, heat exchangers, mixers, gas absorption towers, and so on.

Ice-Production Laboratory.- A small frame building was erected in 1928-29 between the Mining Laboratory and the Ceramics Building for experimental work in ice production. The building was equipped with chemical facilities for the examination of water and with a refrigeration machine and standard tanks for the production and handling of ice. The structure was taken down in the summer of 1936 to make room for the construction of the metallurgical Laboratory.

Gas-Absorption Laboratories- The experimental work in gas absorption was begun about 1930. A complete pilot plant was installed in the Mathews Avenue Power Plant, but was transferred to the Abbott Power Plant when that structure was completed in 1940. This equipment, used for the recovery of sulphur dioxide from flue

gases under actual plant conditions and for studies in power generation, is stationed in a portion of the building that has a clear headroom extending from the main floor to the top of the three-story structure, permitting the use of model stacks through openings in the roof. In addition, there are several specially-built gas absorbers located in the Noyes Laboratory. Besides all of this equipment, there is installed in the Abbott Plant a large modified stack similar to those constructed in one of the large industrial generating stations, designed to serve as a wet cyclone scrubber for the purification of flue gases.

Fractional-Distillation Laboratories.- The experimental work in fractional distillation has been carried on for a number of years, during which time there has been accumulated many pieces of special apparatus consisting of stills, fractioning towers and columns, condensers and receivers, coolers and heat exchangers, rotameters, reflux heaters, and vapor superheaters.

Catalytic-Processes Laboratory.- The laboratory provided at the University for the study of catalytic processes is probably the only one operated in connection with an educational institution. The plant, generally known locally as the high-pressure laboratory, is located in a small wooden building on a plat of ground east of Goodwin Avenue between the Boneyard and the railroad tracks. The building formerly used for storage purposes, was restored to its present condition in 1938.

With the facilities at hand, it is possible to investigate a great many different catalytic processes on a pilot-plant scale and to determine quickly the optimum conditions, pressures, temperatures, concentrations, rates of flow, etc. It is possible to develop pressures ranging from 0 to 50,000 pounds per square inch. Automatic electrical apparatus has been provided to control the temperatures, pressures, and other variables. There are also available in addition to the usual chemicals, a number of automatic recording devices and a selection of analytical equipment to speed up determinations of important factors. Other apparatus includes autoclaves, catalytic generators, steel bombs, automatic

stills, pumps, gas meters, dry and wet test meters, and a moderate supply of shop appliances.

Electro-Organic Chemical Laboratories.- The individual laboratories, devoted to the field of electro-organic chemistry, are located in the Noyes Laboratory, and are adequately furnished with equipment for small-scale experimentation projects. The Department of Chemistry is particularly fortunate in having on hand an abundant supply of rare organic chemicals supplied by the manufacturers of such materials.

B. FACULTY PERSONNEL

General.- Brief biographical sketches of faculty members above the grade of assistant that have been connected with the Engineering Experiment Station in the Division of Industrial Chemistry, or as it is now called the Division of Chemical Engineering, in the Department of Chemistry in the College of Science or the College of Liberal Arts and Sciences, are listed in the following pages in chronological order according to rank.

a. HEADS OF THE DIVISION

General.- Samuel Wilson Parr was Head of the Division of Industrial Chemistry, or Chemical Engineering as it was later designated, from 1891 to 1926, Donald Babcock Keyes from 1926 to 1945, and Henry Fraser Johnstone from 1945 to date. Brief biographical sketches of these men follow.

Samuel Wilson Parr was born at Granville, Illinois, on January 21, 1857. He received the B. S. degree in Chemistry at the University of Illinois in 1884 and the M.S. degree at Cornell University in 1885. During 1900-01 he studied in Berlin and Zurich. He served as Instructor in Illinois College from 1885 to 1886 and as Professor of General Science there from 1886 to 1891. He then joined the staff at the University of Illinois as Professor of Applied Chemistry in the College of Sceince, and held that title until 1926, when he was retired with the title of Professor of Applied Chemistry, Emeritus. He was awarded the Honorary Sc. D. degree by Lehigh University and by Illinois College.

Professor Parr was author of a textbook entitled "The Chemical Examination of Fuels, Gas, Water, and Lubricants". He became a member of the Executive Committee of the Engineering Experiment Station almost as soon as the Station was established and during his connection with it, he became author of three bulletins and co-author of thirteen bulletins and two circulars,- the most outstanding of his work being related to the coking of Illinois coal.

In connection with his investigations, Professor Parr patented a number of scientific instruments, among which was the Parr peroxide calorimeter for coal,-an instrument that possessed great accuracy and that could be produced at moderate cost. It was widely used until 1912, when he developed the metallic alloy known as Illium,- a compound that is strong, that works well under machine tools, and that is immune to the action of nitric and sulphuric acids under high pressure. On account of these characteristics, Professor Parr used it in the construction of the Illium bomb calorimeter, a device that has had a wide acceptance in commercial plants both in this country and abroad. Illium alloy is widely used, also, in the manufacture of acid pumps and other acid-handling machinery in chemical manufacturing plants, fertilizer works, and so on.

Doctor Parr had patents, too, on other carbon apparatus, on a sulphur photometer, a calorimeter for gas, an oxygen-bomb calorimeter, a blast burner, and a low-temperature process for coking coal.

After retiring, Professor Parr continued to make his home in Urbana until his death on May 16, 1931.

Donald Babcock Keyes was born at Westerly, Rhode Island, on February 8, 1891. He received the B.S. degree at the University of New Hampshire in 1913, the S.M. degree at Columbia University in 1914, and the Ph. D. degree at the University of California in 1917. He served as chemical engineer in practice from 1917 to 1926 after which he came to the University of Illinois as Professor of Chemical Engineering and Head of the Division of Chemical Engineering in the College of Liberal Arts and Sciences. Professor Keyes was a member of the Executive Committee of

the Engineering Experiment Station. He is author of three circulars and one reprint and is co-author of four Bulletins of the Station. His work contributed extensively to the fundamental knowledge of oxidizing catalysts and distillation, and the University was very fortunate in securing Doctor Keyes for this important position. After January, 1943, he spent much time in Washington, D.C., in connection with war-time production work, serving for a time as Chief of the Chemicals Section of the Office of Production, Research, and Development, a Divisi Division of the War Production Board, and later as Director of the Office itself. Doctor Keyes did not return to resume his University Work, but resigned at the end of August, 1945, to accept a position in industry.

Henry Fraser Johnstone was born at Georgetown, South Carolina, on December 16,1902. He received the B.S. degree at the University of the South in 1923, the M.S. degree at the University of Iowa in 1925 and the Ph.D. degree there in 1926. He served as Assistant Professor of Chemistry at the University of Mississippi from 1926 to 1928, then he came to the University of Illinois as Research Assistant in the Engineering Experiment Station. He was made Research Associate in 1929, Research Assistant Professor in 1931, Assistant Professor in 1935, Associate Professor in 1936, and Professor of Chemical Engineering in 1939. He became Head of the Division of Chemical Engineering and a member of the Executive Committee of the Engineering Experiment Station in 1945. Professor Johnstone is author of one bulletin, one circular, and one reprint, and is joint author of two bulletins of the Engineering Experiment Station dealing with the study of the recovery of sulphur dioxide from stack gases. He and his associates have been successful in developing several methods that have important commercial significance. His basic studies on absorption have also attracted international interest. Doctor Johnstone was honored with the William H. Walker award for the American Institute of Chemical Engineering at the annual meeting of the organization in May, 1943, in recognition of his two outstanding papers contributed to the transactions of the society, viz: "Distillation in a Wetted Wall Column", and "Heat Transfer to Clouds of Falling Particles".

b. OTHER PROFESSORS

Frederick Guy Straub, (B.S., 1920, University of Illinois; M.S., 1923, and Met. E., 1928, Pennsylvania State College), was employed in research work in Engineering practice during 1920-21, then served as Instructor in Pennsylvania State College during 1921-23, after which he returned to practice. He joined the staff of the University of Illinois in 1924 as Special Research Associate, and became Special Research Assistant Professor of Chemical Engineering in 1925, Special Research Associate Professor in 1936, and Special Research Professor in 1941, which position he holds to date. Professor Straub is author of four bulletins and one reprint and is joint author of two bulletins issued by the Engineering Experiment Station in the field of boiler-water treatment for high-pressure boilers. It has been repeatedly acknowledged by the utilities that the results of these investigations have literally saved the industry many millions of dollars.

Sherlock Swann Jr. (B.S., 1922, Princeton University; Ph. D., 1926, Johns Hopkins University), was engaged in chemical engineering practice during 1926-27, then joined the faculty at the University of Illinois in 1927 as Assistant, serving in turn as Research Associate during 1929-32, Research Assistant Professor during 1932-37, Research Associate Professor of Chemical Engineering from 1937 to 1941, and Research Professor from 1941 to date. He is acknowledged to be one of the leading authorities in the United States on electro-organic reductions. He is author of two bulletins, one circular, and two reprints and is co-author of one bulletin of the Engineering Experiment Station. The results of his investigations have been made use of extensively both in this country and abroad.

d. ASSISTANT PROFESSORS

Dana Burks, Jr. (B.S., 1924, A.M., 1925, and Ph. D., 1928, Stanford University), was Instructor at Stanford during 1927-28, then became Assistant in Chemical Engineering at the University, serving in turn as Research Associate during 1929-30 and Research Assistant Professor during 1930-32. He resigned to engage in chemical engineering practice. He is author of three bulletins of the

Engineering Experiment Station. Doctor Burks' experiments very greatly improved the processes of manufacture of ice, increasing the efficiency of so-called standard plants by as much as 30 percent. The results of his researches are employed in all progressive ice plants in this country.

Robert Dewey Snow, (B.S., 1923, M.S., 1924, and Ph. D., 1926, University of Iowa), was employed in research work in chemical engineering practice from 192 6 to 1929. He then became Special Research Assistant in Chemical Engineering at the University of Illinois. He was made Special Research Associate in 1930, and Special Research Assistant Professor in 1931. He remained with the University until May, 1932, when he left to return to engineering practice. Professor Snow is joint author of one bulletin of the Engineering Experiment Station.

e. ASSOCIATES

Floyd Beatty Hobart, (B.S., 1920, and M.S., 1921, University of Illinois), served as Research Assistant in Chemical Engineering from 1921 to 1926, and as Research Associate from 1926 to 1927.

Alfred Crawford Robertson, (B.S., 1922, Oregon State College; M.S., 1924, and Ph. D., 1925, University of Wisconsin), was engaged in research work at the California Institute of Technology during 1925-27, then served as Associate Technologist for the U.S. Bureau of Fisheries during 1927-29. He joined the staff at the University of Illinois in 1929 as Special Research Assistant in Chemical Engineering. He became Special Research Associate in 1930, and remained in that position until December, 1931. He then worked on a fellowship at Copenhagen for a year, after which he went into commercial practice.

Paul Erwin Peters, (A.B., 1927, Missouri Wesleyan College; M.S., 1928, and Ph. D., 1930, University of Iowa), served as Special Research Assistant during 1930-31, and as Special Research Associate from September, 1931, to October, 1932. He resigned to accept a position with the North Shore Coke and Chemical Company.

Edward Arthur Parker, (B.S., 1930, M.S., 1932, and Ph. D., 1937, University of Illinois), served as Special Research Associate in Chemical Engineering from September, 1939, to July, 1941.

Theodore Ambrose Bradbury, (B.S., 1933, and M.S., 1937, University of Illinois), occupied positions in chemical engineering with the State and in industry until he joined the staff here in September, 1944, as Special Research Associate in Chemical Engineering on the cooperative investigation of Solubility of Boiler Waters.

f. SPECIAL RESEARCH ASSISTANTS

Wilfred Forrest Wheeler, (B.S., 1906, University of Kansas; A.M., 1909, University of Illinois), served as First Assistant in the Department of Chemistry for the Engineering Experiment Station during 1908-09 until his death on November 17, 1909.

David Ford McFarland, (A.B., 1900, and A.M., 1901, University of Kansas; M.S., 1903, and Ph. D., 1909, Yale University), was Instructor in Chemistry in the University of Kansas during 1900-08 and Assistant Professor of Chemistry there during 1903-10. He served as First Assistant in the Department of Chemistry for the Engineering Experiment Station here during 1910-15. He then became Associate Professor of Applied Chemistry here. He is co-author of one bulletin of the Engineering Experiment Station.

Thomas Ernest Layng, (A.B., 1909, and A.M., 1912, McMaster University; Ph. D., 1916, University of Illinois), served as Research Assistant in Chemistry during 1917-18. In September, 1918, he became Associate in Chemistry and in September, 1920, Assistant Professor of Chemistry. He resigned in 1921 to go into commercial work.

Homer Russell Duffy, (B.S., 1926, Shurtleff College; M.S., 1928, University of Illinois), was employed as Special Research Assistant in Chemical Engineering from September, 1928, to February, 1929.

William Lawrence Faith, (B.S., 1928, University of Maryland; M.S., 1929, and Ph. D., 1932, University of Illinois), served as Special Research Assistant in Chemical Engineering from September, 1931, to January, 1933. He is joint author of one bulletin of the Engineering Experiment Station.

Joseph John Picco, (B.S., 1933, Missouri School of Mines and Metallurgy), was Special Research Assistant in Chemical Engineering here during 1933-34.

Manjit Dhaliwal Singh, (B.S., 1929, and M.S., 1930, University of Illinois), became Special Research Assistant in Chemical Engineering here in September, 1936. He resigned in July, 1942. Mr. Singh is author of one circular and is co-author of one bulletin of the Engineering Experiment Station.

Henry Andrew Grabowski, (B.S., 1942, University of Illinois), became Special Research Assistant in Chemical Engineering in September, 1943, but withdrew in September, 1944.

SUMMARY

General.- Although the Division of Chemical Engineering, or industrial Chemistry as it was originally known, is under the general administration of the Department of Chemistry in the College of Liberal Arts and Sciences, it has been very active in carrying on research in the Engineering Experiment Station ever since the Station was established in 1903. It has practically an unlimited amount of equipment available for use, for in addition to its own liberal assortment of apparatus for conducting its projects, it has access to all the facilities of the Department of Chemistry, one of the largest in the campus area.

The contributions made by the Division to the improvement of chemical and electrochemical processes resulting from years of persistent effort on the part of the staff, can scarcely be reckoned in monetary values to industrial and commercial organizations within the State. The studies have led to greater efficiency in operating economy and to a more effective utilization of natural resources resulting in the production of better products and services for the citizens of this region.

CHAPTER XX

MISCELLANEOUS UTILITIES OF ENGINEERING INTEREST DEVOTED TO UNIVERSITY SERVICE

A. UNIVERSITY HEATING, LIGHTING, AND POWER PLANTS

General.- The University has always maintained its own heating, lighting, and power facilities,-for the most part in a central plant located within the campus area. Brief descriptions of these plants follow in the next few pages.

University Hall Central Heating, Lighting, and Power Plant.- The first central heating plant on the campus was constructed in the fall of 1881, in a one-story building that stood directly back of University Hall. It is described in the 1882 Report of the University of Illinois[1] as follows:

"The Boiler House is 34 x 80- and 14 feet in height of wall. Its north end forms the south side of the quadrangle of the main building. Its floor is depressed four feet below the surface, and is covered with concrete. The first six feet of its walls are rough rubble laid in cement; the remainder of its walls is of old brick surfaced with new. The roof is of matched flooring covered with metallic shingles. The interior is divided by a partition. The north end contains two boilers, which furnish steam for the main building through a six-inch pipe. The capacity of the two boilers is 75 horsepower each. Space remains for a third boiler, when it shall be removed from the Chemical Building. The room also contains a small high-pressure boiler, and the steam- pump, heater, etc. The south end has an estimated capacity of receiving 250 tons of coal.

"The boiler flues are taken about 60 feet under ground to the chimney, which is placed south of the east wing of the main building, and as near as the foundation would permit. The foundation is twelve feet square, and is ten feet below the surface of the ground. With the first ten feet of the chimney above ground the foundation is of rough stone masonry laid in cement. The remainder of the chimney is of brick, and is circular above the octagonal stone base. The work has been excellently done. The scaffolding was placed inside the chimney and when removed the interior surface was smoothly plastered with lime and salt. The draft proves to be all that could be desired. The season was so far advanced before the work was done that it was not thought best to attempt the removal of the boiler from the Chemical Building, which is therefore deferred to the future.

"One of the boilers in the new house is new, taking the place of a condemed boiler from the basement of the main building. Thus far one of the boilers supplies abundant steam, and it is hoped that the second boiler in reserve will give us such power of warming the building in extreme cold weather as has never before been enjoyed[2].

"The area of the quadrangle has been neatly graded, and such walks and approaches have been made about the boiler house as are required for delivery of coal and other purposes."

1. Page 208
2. In addition to the boilers in this central plant, three others all of 40 horsepower horizontal tubular type, were installed in the old Mechanical Building and Drill Hall on the north campus,- one in 1890 to heat that building and provide power for the shops, one in 1892 to heat the armory, and one in 1895 to heat Machinery Hall (Now Machine Tool Laboratory).

Most of the brick used in the construction of the building and chimney were salvaged from the old Dormitory on the north campus when it was razed during the previous summer.

The heating capacity was gradually expanded as changes were made and new buildings were erected. A new 110-horsepower Sterling boiler was added in the fall of 1892 to heat the old Chemistry Building (Harker Hall) and the first unit of the Natural History Building, and two new 220-horsepower Babcock and Wilcox boilers were put in in the fall of 1894 to heat Engineering Hall.

The building was taken down about 1902-03,-several years after the construction of the Boneyard plant,-and the chimney was removed in 1910. The chimney was badly cracked and was considered dangerous. Besides, it no longer served any useful purpose.

The electric-light plant was set up in the quarters occupied by the Department of Physics and Electrical Engineering, which was located on the ground floor of the east wing of University Hall. For a short time, the plant was powered by a 10-horsepower Atkinson-cycle gas engine procured in the summer of 1891, but because of difficulties in operation, a 60-horsepower "Ideal" steam engine manufactured by Ide and Son of Springfield was installed early in 1892. The boiler which supplied the steam for the Ide engine was a 60-horsepower water-tube Sterling type[1] and was set at the same time as the steam engine in the old boiler-room in the east wing of that same building.

The electrical equipment driven from a jackshaft, consisted of the Weston 5-light arc lighting generator obtained in 1886, a Thomson-Houston 300-light alternating-current generator, and a Thomson-Houston 35-light direct-current generator, both installed in 1891. Shortly after 1891 several other dynamos[2] were added to the facilities of the Department of Physics and Electrical Engineering although it is not clear how many of them, if any, were used for central-lighting purposes.

1. This boiler was also used to supplement the 110 horsepower Sterling in heating the Chemistry and Natural History buildings after 1892.
2. These are listed under Physics in Chapter XV. Previous to 1891, the University buildings had been lighted by gas.

The Boneyard Central Heating, Lighting, and Power Plant.- The second central heatin lighting, and power plant was constructed in 1897-1898. The following discussion of the purposes of the new plant is summarized from an article provided by Professor L. P. Breckenridge in The Technograph.[1]

The rapid growth and development of the University of Illinois rendered it imperative that increased facilities should be installed for the proper heating of the buildings already erected on the campus. The completion of the Library during the summer of 1897 added 3,000 square feet of hot-blast radiation to the system. Largely on account of insufficient chimney draft, the boiler capacity of the old plant was not adequate to handle any increase in radiation. All of the water of condensation from Engineering Hall was being discharged into the Boneyard. The operation of two plants, one for the north and one for the south end of the campus, was not economical and smoke was always a nuisance, whether the wind was north or south. On account of the poor chimney draft, it had been necessary to burn lump coal costing the University from $1.75 to $2.25 a ton. The coal consumption for the years 1895-96 and 1896-97 had been about 3,500 tons.

In the design of the new plant, it was the aim of the writer to accomplish the following results:

1. To concentrate at the lowest point on the campus, all of the heating boile

2. To provide increased draft, so that the cheaper grades of coal might be used for fuel.

3. To prevent smoke.

4. To provide a system of tunnels large enough to carry the heating mains, water mains, gas mains, compressed-air mains, vacuum mains, as well as for electric light and power purposes.

5. To concentrate all engines near the boiler house so that all exhaust steam might be used for heating purposes.

6. To provide 1,000 incandescent lights for the buildings and 20 arc-lights for the campus.

7. To provide electric current for running motors for power purposes at any point on the campus.

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1. Vol. 12, 1897-98, pages 79-85

8. To arrange this entire plant so that, as far as possible, it might be available for educational purposes.

The new plant was located in the 55-by 120-foot brick building[1] that now stands directly north of the Boneyard and the University Fire Station. A complete description of the building and the stack was presented in The Technograph, from which the following extracts were taken[2].

The walls of the long sides were twenty-six feet high. The west wall was covered on the inside by coal bins and coal-handling machinery, and the east wall had outside along its entire length a smoke funnel five feet wide and twelve feet high. This connected with the chimney at the middle of the wall and with the various boilers which occupied that side of the building. The boiler house was lighted by clerestory windows on both sides. Seven light steel trusses of special design supported the roof. To the south extended a pump, tool, and stock room 25 by 50 feet. This portion of the building crossed the Boneyard and provided an entrance to a system of tunnels which connected the various buildings. The boiler house and stack were constructed of common red brick, laid in red mortar.

The brick stack, which had an inside diameter of 6 feet and a height of 150 feet, stood on the east side of the building about midway between the two ends of the structure. It rested on a solid foundation of Portland cement concrete 6 feet thick which decreased in six steps from 24 feet and 8 inches square at the base to 18 feet square at the top. The stack had a separate core extending to a height of 90 feet, the lower 40 feet being 12 inches thick, the next 30 feet, 8 inches thick, and the last 20 feet, 4 inches thick. It was entirely free from the chimney wall and was never nearer to it than two inches.

The stack proper rested on a base 34 feet high. The shaft itself was circular and consisted of a 24-inch wall to a height of 54 feet, where it was reduced to a 20-inch wall to a height of 76 feet, then to an 16-inch wall to a

1. Building designed by Professors C.D. McLane and S.J. Temple. This site was chosen by Professor Breckenridge because it was the lowest point on the campus.

2. The Technograph, Vol. 12, 1897-98, by S.J. Temple, Assistant Professor of Architecture, Pages 44-46.

height of 98 feet. A 12-inch wall then extended to a height of 123 feet where the ortamental top began. The cap was 27 feet high and consisted of an 8-inch wall strengthened by 2-inch rods every 8 inches. The stack was laid in cement mortar above 76 feet, and all the joints on the outside were raked out and pointed up after completed. There was an iron ladder running from bottom to top on the inside and a cast-iron cap protected the upper course from disintegration.[1]

The general contractors for both building and stack were M. Yeager & Son of Danville, Illinois. The iron and steel work was furnished by the La Fayette Bridge and Iron Company of La Fayette, Indiana. The contract price for the building was $37,935, which could be divided approximately as follows: Chimney $4,000; boiler house, $9,500; laboratory building $24,435. The building cost a trifle over 7 cents a cubic feet, and the boiler house a trifle under 4 cents a square foot.

During December,[2] 1897, one new 250-horsepower National Water Tube boiler was set in this new power house. This boiler was equipped with a Murphy smokeless furnace and automatic stoker. The boiler was fired up on December 28 and Steam was turned into the heating system from it on January 3, 1898. A Berryman closed feed-water heater was set so that the exhaust steam from the engine might be turned through it or around it as desired.

The two 220-horsepower Babcock and Wilcox boilers, formerly used in the old University Hall Central Plant were set in May, 1898, and were equipped with Roney mechanical stokers. the 110-horsepower horizontal tubular boiler[3], moved from University Hall itself, was set with a Brightman stoker. The coal and ashes were

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1. The stack was taken down in about 1921 or 1922, and the brick was used as back up brick in the construction of the first unit of what was then called the North Garage, now a part of the Nuclear Radiations Laboratory.

2. The mechanical and Electrical Engineering Laboratory and the boiler house were to be finished by December 1, 1897, according to the contract. The boiler house was finished on schedule, but the laboratory part required an additional ninety-seven days.

3. Removed during 1905.

handled by machinery, -the coal-storage capacity being about 600 tons, and the coal consumption in 1897-98 being about 3,500 tons.

Some of the smaller details of the boiler-house equipment consisted of a No. 6 Schaeffer & Budenberg exhaust steam injector, a Locke damper regulator, Davis'back pressure valves, 8-inch Lyman exhaust head, Worthington 2-inch hot-water meter, Crosby recording pressure gages, feed pumps with automatic control from return tanks, oil filters, and Austin separators.[1]

A short time later, there was added one 150-horsepower Babcock & Wilcox special boiler carrying a 275-pound steam pressure, equipped with a hand-feed furnace, and one 150-horsepower standard Babcock & Wilcox boiler supplied with a Babcock and Wilcox chain-grate stoker, making the total rated horsepower about 1,100. Two 200-horsepower Sterling boilers equipped with chain grates and automatic stokers were installed during 1905. Still other boilers were added until in 1907, the boiler capacity had been increased to about 1,800 or 2,000 horsepower.

For a time, coal was hauled to the plant in wagons, but in 1906, the Illinois Traction System put in a spur from its tracks to the north. This line was removed in 1919 at the time of the construction of the third unit of the Mathews Avenue Power Plant.

The engine and generating equipment provided for the power plant was installed in the West end of the east wing of the Mechanical and Electrical Engineering Laboratory in the early part of 1898. It consisted of one 60-[2]horsepower "Ideal" single-cylinder, high-speed engine; one 50-horsepower Westinghouse "Junior" engine; and one 100-horsepower Ideal tandem-compound engine. These engines, supplied with

1. Descriptions taken largely from an article "The Central Heating, Lighting, and Power Plant", by L. P. Breckenridge in the Technograph, 1897-98, pages 79-85.

2. Listed in some descriptions as 50 horsepower. It was originally installed on the ground floor of University Hall in 1892 as a part of the Department of Physics Power Plant.

high-pressure steam through an independent main from the boiler house, were used mainly to drive the electric generators describedin the following paragraph.

The electrical equipment operated by the above steam power, was provided to furnish current for the incandescent lamps in the buildings, for the arc lamps on the campus, and for the motors which ran the machine shop, the dynamo and other laboratories, and the ventilating fans in the several buildings. The generating equipment included one Westinghouse 45-kilowatt, 440-volt, 2-phase, 60-cycle, alternator, belted; one Westinghouse 75-kilowatt, 440-volt, 2-phase, 60-cycle, alternator, belted; one 30-kilowatt, 500-volt direct-current generator; and one 25-kilowatt, Wood arc light generator that supplied current for the 25 arc lamps on the grounds and in Military Hall. The plant was provided with a transformer to reduce the pressure from 440 volts to 110 volts for the incandescent lamps. In the latter part of 1902, there was added a 120-kilowatt, 440-volt, 2-phase, 60-cycle, Westinghouse generator with revolving fields, directly connected to a Westinghouse compound steam engine of 200 horsepower, and the 45-kilowatt machine was returned to the manufacturer.

The electric plant was discontinued in 1911-12, after the Mathews Avenue plant had been placed in service.

<u>The Mathews Avenue Heating, Lighting, and Power Plant.</u>- The first unit of the Mathews Avenue Heating, Lighting, and Power Plant, a four-story brick structure, was completed about June 1, 1910, at a cost of $75,000, and the equipment was installed shortly thereafter. Two Babcock and Wilcox longitudinal-drum boilers, each of 500 horsepower, operating under natural-draft conditions at 150 pounds steam-pressure, were provided with cast-iron headers and with Green Engineering Company's chain grates. The Chimney, erected by the Alphons Custodis Chimney Construction Company of Chicago, was 10 feet in diameter at the top and was 175 feet in height above the boiler-room floor, which gave it a rating of about 3,500 horsepower. The plant began full-load operation on December 22, 1910. It was largely for heating purposes, for the lighting and power loads made comparatively small demands.

Some of the engine and generating equipment including the 120-kilowatt Westinghouse plant mentioned in the preceding section, was transferred from the old power plant to the new one. In addition, a Ball non-releasing Corliss engine, directly connected to an Allis Chalmers Company 250-kilowatt, 440-volt, 2-phase, 60-cycle, generator, and a 125-kilowatt, 2,300-volt, Curtis turbo-generator set were installed. The Ball engine and the turbine could carry the full electric load required of the plant. A simple engine was chosen because the exhaust steam was used for heating, and the engine, therefore, served only as a reducing pressure valve for the heating system. As previously stated, however, the electrical equipment of the Boneyard plant was kept running until the beginning of the school year 1911-12.

The new mechanical equipment was decided upon by W.L. Abbott, president of the Board of Trustees, and Dean Goss of the College of Engineering. Plans for the building were prepared by W. C. Zimmerman, the State Architect, Details of piping, wiring, etc., together with the selection of pumps, feed-water heaters, and so on, were entrusted to W. H. Zimmerman, '96, Consulting Engineer, of Chicago. The general contract was awarded to E.C. English, '02.

During 1914, an addition was made to the new power plant. The spur to the Boneyard plant was moved slightly and the new building was extended to the west of the original structure along the railway tracks. Two more Babcock & Wilcox boilers duplicating the first set of slightly over 1,000 horsepower, were installed in 1915-16, thereby doubling the boiler capacity of this plant, making about 2,200 in all. At that time, the link-belt coal-and ash- handling system was installed. The coal was unloaded from cars on the Illinois Traction siding to a hopper beneath the track, from which it was carried by a pan conveyor to a crusher and then to a bucket conveyor. This conveyor elevated the coal to the hopper-bottom, cylindrical steel bunkers, which had been provided because there was so much danger from spontaneous combustion with the low grade of fuel used, that it was felt necessary to have the bunkers so constructed that the coal would be

continuously moving. The coal was fed directly from the bunkers to the automatic stokers.through individual electrically-operated scales provided to measure the coal consumption. A 200,000-pound Buffalo platform scale was installed in the unloading track immediately in advance of the unloading hopper,

In 1920, another extension was made to the power-plant building and two more Babcock & Wilcox boilers of the same capacity as those previously installed, were added. In 1925, another two of similar make and capacity were put in, making eight altogether in service totalling about 4,400 horsepower. All of these boilers were equipped with natural draft operating equipment; but when it became necessary in 1935 to repair the two original boilers, they were remodelled to operate with forced draft.

In 1920, the original 125-kilowatt Curtis turbo-generator was retired[1] to make room for a 500-kilowatt, 2,300-volt, 3-phase generator driven by a horizontal Curtis steam turbine. In 1925, another 500-kilo-watt generating unit duplicating the 1920-model, was installed. A 1,000-kva generator having a direct-connected exciter and being driven by a single-stage General Electric non-condensing steam turbine, was added in 1929,-being placed into operation on September 16 of that year. The turbine was designed for 140 pounds steam pressure and 15 pounds back pressure. The operation was non-condensing because of the need for exhaust steam in the heating system. The turbine ran at 3,600 r.p.m., and was directly connected to the 2,300-volt, 3-phase, 60-cycle, alternating-current generator.[2]

During this period from 1921 to 1929, the stand-by connection with the local power company was increased from 250-kilowatt to 750-kilowatt capacity, then to 1,000 and finally to 1,500, making a total electrical capacity of 3,500 kilowatts.

A second radial-brick chimney 15 feet inside diameter at the base and 13 feet at the top, was erected for the power plant in the summer of 1930. The walls

1. At that time the generating equipment consisted of the Allis-Chalmers 250-kilowatt machine driven by the Ball engine, the Westinghouse 120-kilowatt generator driven by a Westinghouse vertical single-acting engine, and the 500-kilowatt generator,

2. The Technograph, November, 1929, Page 23.

were 24 inches thick at the bottom and $8\frac{1}{2}$ inches at the top, and were laid with firebrick for a height of 50 feet above the breech.

Since the boilers in the plant were no longer used after the new Abbott Power Plant, described in the next section, was completed in 1940, they were removed, the two chimneys were taken down a short time later, and the boiler-room portion of the building came to be used by the Physical Plant Department for service, storage, and other purposes. The 500-kilowatt generators were removed, also, but the 1,000-kilowatt generator and the steam turbine were left in place, although they were not used in 1945. There was also left there the 100-kilowatt motor-generator set installed in 1924 for supplying direct current for general campus use. In 1941, the Ball engine was transferred to the brake-shoe laboratory, as previously mentioned.

<u>William Lamont Abbott Power Plant.</u>[1] - Because the facilities of the Mathews Avenue Power Plant would not be able to meet the demands that would be imposed in serving the needs of several new major buildings to be located on the middle and south campus, it was decided to erect an entirely new power, heating, and lighting plant along lines of more modern power-plant construction. The site chosen was one on the southwest campus in a section adjacent to the right-of-way of the Illinois Central Railroad Company, where track and coal-storage facilities could be conveniently provided.

This plant, designed by Sargent and Lundy, Inc., was constructed between January, 1940, and February, 1941, at a cost of $1,585,934,- the plant having been placed in operation on September 23,1940, and having been operated in parallel with the Mathews Avenue Plant until February, 1941. The three steam generating units each having a continuous capacity of 80,000 pounds of steam per hour when burning central or eastern Illinois screenings of 10,000 B.t.u., were procured from the Springfield Boiler Company. They were equipped with three Babcock-Wilcox forced-draft chain grate stokers. The coal-handling system designed to move 75 tons of fuel per hour, was constructed by the Jeffrey

1. Some of the material in this section was taken from The Technograph, May, 1944, pages 7-9.

Manufacturing Company. The United Conveyor Corporation furnished the ash-and dust-handling system, and the Richardson Scale Company supplied the six automatic scales for weighing the coal. The concrete chimney was constructed by The Heine Chimney and Construction Company. The two 3,000-kilowatt turbo-generator units, operating at 3,600 r.p.m.,- one an automatic-extraction condensing turbine and the other a non-condensing turbine,- were manufactured and installed by the General Electric Company, a Whiting 15-ton travelling crane having been provided to handle and service them.

The construction of this plant made it possible to expand the building program to cover the present requirements for instructional and experimental purposes and to provide for additional capacity for future growth in the building and campus plan. This assemblage of structure and equipment was very appropriately named the William Lamont Abbott Power Plant in honor of one of the University's most distinguished alumni engineers and who was for many years a member of the Board of Trustees of this institution.

B. WATER SUPPLY STATIONS

University Water-Works Plant.[1]- With the growth of the University and the construction of many new buildings, there came a largely-increased consumption of water; and this fact and the desire to serve facilities for experimental work led to the construction in 1901-02 of the first unit of the University waterworks. The plant consisted of wells, storage tanks, pressure tanks, pumps, distribution mains, and a reservoir. Extensions were made to old mains and the connections to the city mains were closed by gate valves.

The water-works building was located at the south end of the Boneyard boiler house and pump-room addition. The building, 38 by 73 feet, constructed of pressed-brick, contained pumps and tanks, and also the hose carts and other fire-protecting apparatus. In 1936, this building was remodeled somewhat and

1. "University Water Works," by A. N. Talbot, in The Technograph, Vol. 16, 1901-02, page 87-88. Professor Talbot designed and supervised this first installation.

thereafter used to house the University Fire trucks.

Two 8-inch wells located within the building were 145 feet deep and afforded a supply of wholesome water, which rose at that time to within 60 feet of the surface. Chemical analysis showed that the water was quite similar to that of the city supply. A Downie double-acting, deep-well pump lifted the water from one well and an air lift drew it from the other, discharging it into storage tanks.

An 8 by 6 by 10-inch Snow duplex double-acting steam pump was used to supply water from the storage tanks to the mains for ordinary service, and a Knowles 16 by 9 by 12-inch underwriter's fire pump was used for fire pressure. Steam was maintained on the fire pump to keep it moving slowly. Space was left for other pumps to be installed later.

Two steel storage tanks 20 feet in diameter and 10 feet high, each having a capacity of 43,000 gallons, received water from the wells. Two steel tanks, 8 feet in diameter and 22 feet long, under air pressure, served as reservoirs, allowing the pumps to run more steadily under greater varying consumption of water or even to be shut down for a time. The tanks were built to take a pressure of 125 pounds a square inch. An outside reservoir built of concrete and holding 100,000 gallons was kept for a reserve.

As the plant was to be used for experimental purposes, also, the arrangement of suction mains, pressure mains, valves, pumps, tanks, and reservoir, was made especially to facilitate such work without interference with the University supply. A separate pressure main extended to the hydraulic laboratory, which also had a connection with the storage tanks and suction main connected with the sump of the laboratory. The average amount of water pumped was 100,000 gallons per day.

In 1907, there were four 8-inch wells 145 feet deep. By 1914, one 12-inch well 148 feet deep had been added, and by 1920, still another one was in service, making six in all at that time.

A new water filtration plant was put into operation in the summer of 1931. The original wells had been abandoned, and water was obtained at that time from seven other wells which were bored into sand and gravel veins. These wells ranged from 16 to 22 inches in diameter and from 140 to 260 feet in depth. The water level stood about 100 feet below the surface when the wells were not in use, but dropped about 35 feet when the pumps were in operation. Because of this, it was necessary to place the pumps near the bottom of the wells. The small-diameter wells were equipped with reciprocating plunger pumps, while the newer and larger wells were equipped with a type of centrifugal pump called the "deep well turbine". With these two types of pumps, it is very essential that wells be straight. The motors and supports are at the surface and are connected with the pumps by long shafts and rods. If the wells are not reasonably straight, the shafts are continuously subjected to reversals of stress which may result in fatigue of corrossion-fatigue failure.

Raw water drawn from wells in different parts of the north campus contains iron in bicarbonate form and also bacterial growth which make it unsuitable as a public supply. The iron causes a red stain to form on fountains and plumbing fixtures, and is instrumental in hastening bacterial growths while the bacteria are undesirable because they pollute the pipes and endanger the health of the people who use the water. These impurities necessitate a plant designed primarily for the removal of iron and secondarily for the removal of bacteria.

As the plant is operated, water is pumped directly from the wells to an aerator located immediately back of the Electrical Engineering Building. This aerator surrounding the raw-water basin or reservoir, consists of an annular perforated pipe so constructed that after spraying the water several feet into the air, it allows it to fall into the basin,-the chief purpose of the aerator being to precipitate the iron, changing it to ferric oxide and leaving in the reservoir a very finely-divided precipitate in suspension. Other functions of the aerator are to add oxygen and to release other gases with a consequent reduction of tastes and odors.

From the raw-water basin, the supply is pumped to the filter plant back of the foundry laboratory by two filter pumps, each having a capacity of 1,500 gallons per minute against a head of 50 feet. The raw-water chlorinator is located on the pipe between the raw-water basin and the filter pumps, ordinarily all of the chlorine being added at this stage. It is necessary to add chlorine to the water before filtration to minimize the growth of organisms in the filters. Chlorine is added to the extent of about three parts per 1,000,000, but all except a small part is used to kill the growth in the filter sand. Tests are made three times during the day to learn if the proper amount of chlorine is in the service water. Since chlorine is the only chemical constituent ordinarily added, and since it is added in the pipe line back of the filter pumps, it is thoroughly mixed before it reaches the filtration plant.

Under ordinary conditions, all four filter units, are operated simultaneously for 18 hours a day, starting at 6:00 a.m. and closing down at midnight. The filters are of the "rapid-sand" type, with a 4-foot bed of sand. Each filter is washed once a day by a special air compressor and back-wash pump. The water does not go through a coagulatory basin, but runs by gravity from the filters to the clear-water basin located on Springfield Avenue immediately north of the filter house. This clear-water basin is a covered, cylindrical concrete reservoir having a capacity of about 250,000 gallons, or about one-fifth of the average daily demand in 1931 when it was built. At that time, the basin was large enough to furnish water during the night hours, for the demand was relatively light then.

From the clear-water basin, water is pumped into the distribution system by four service pumps having a capacity of 3,000 gallons per minute against a head of 150 feet. Ordinarily, all of the pumps are not operated simultaneously. The head in the distribution system is kept at about 50 or 60 pounds pressure per square inch.

Two new wells, known in the records as Nos. 10 and 11, located on Illinois Field, were provided in 1935, and a new 500,000-gallon storage tank was erected at

that time on one of the high points on the South Farm immediately south of the University golf links. The supply and pressure provided by the tank are still sufficient to operate the water system at night without the use of pumps.[1]

C. UNIVERSITY RADIO BROADCASTING STATIONS

Radio Station W-R-M.- The University broadcasting station W-R-M, opened in 1922-23, constituted a part of the equipment of the Department of Electrical Engineering and was operated by the Department under the general supervision of Professor E.B. Paine, Head of the Department. The technical work was under the charge of H. A. Brown, radio instructor in the department. The station operated on a wave-length of 360 meters with power output of about 500 watts. Two 250-watt oscillator tubes were used with three similar tubes acting as modulators. The power supply for the large tubes was obtained from a motor-generator set giving 2,000 volts direct current for the plate voltage. The power for the speech amplifiers was obtained from ordinary "B" batteries, except for the last stage which consisted of a 50-watt tube with a 500-volt dynamotor supplying the plate voltage.[2]

The studio was located in the Electrical Engineering Laboratory, but broadcasting could be done from other points by the use of the telephone line and a portable two-stage amplifier. The Station, used to broadcast musical programs, results of athletic contests, and other University activities, was discontinued in 1925 when the new Station W-I-L-L was completed, as described in the next paragraph.

Radio Station W-I-L-L.- A new University Radio Station designated as W-I-L-L was constructed during 1925-26 partly through a gift of $40,000 by Boetius H. Sullivan in memory of his father, Honorable Roger C. Sullivan. The design, erection, and equipment of this station were placed entirely in the hands of the Western Electric Company of Chicago. The station was located back of the old Gymnasium near the southwest corner of Illinois Field on the north campus and the antenna

1. The material for much of the description of this newer portion of the plant was taken from an article "The University of Illinois Water Supply" by I.L. Wissmiller, the Technograph, November, 1932, page 11.

2. Described further under Chapter XIV, the Department of Electrical Engineering.

erected near-by, extended from a tower on the west to one on the east side of the Field. After completion, the station was taken over and operated by the Director of Public Information and Radio Station, serving directly under the President of the University.

The Station, operating on a frequency of 890 kilocycles with a power of 1,000 Watts, was used to radiocast educational programs from classrooms, to give short educational talks, to present musical recitals by faculty and students, and to present news items, market quotations, and other public service reports, entirely free from commercialism and commercial announcements. Until 1942, the Station broadcasted on week days, and after that, on Sundays as well.

In 1937-38, the frequency of the Station was changed from 890 to 580 kilocycles. This lowering of the frequency permits greater service area. Twin towers, erected as antenna or "vertical radiators", without wires strung between them, are each 325 feet high, which is more than twice the size of the old towers back of the old Gymnasium. The towers are located about one and a half miles south of the Memorial Stadium on the First-Street road. A modern frame building with a floor space of approximately 20 feet by 36 feet was erected there, also, to house the broadcasting transmitter and its associated power supplies and speech equipment.[1] A new 5,000 Watt transmitter was installed in 1938-39 to replace the old 1,000-Watt instrument.

Most of the programs now originate in the new studio in Gregory Hall on Wright Street. This studio, opened in 1942, is connected by wire lines with the new transmitter described above. Other programs, as remote pick-ups, come from points of interest on the campus, such as various class-rooms, the Auditorium, Smith Memorial Music Hall, George Huff Gymnasium, and so on.

D. UNIVERSITY AIRPORT

General.- In May, 1943, the Sixty-third General Assembly appropriated $250,000 for the construction of a University airport based upon plans that originally called for a ground area of 640 acres, and $500,000 for buildings. Because of the interest

1. The Technograph, February, 1937, Page 20

the Federal Government had in the project, officials of the Civil Aeronautics Administration exercised a major influence in the selection of the site.

The plot chosen lies about five miles southwest of the campus,-the center of the field being one and a quarter miles west and one mile south of Savoy,-and is conveniently located for both rail and truck-line highway transportation. In order to provide safety zones at each of the four corners of the area, additional acreage was provided, increasing the total area to about 762 acres. Title to the land was aquired during the fall of 1943 and early part of 1944. In support of its interest in the undertaking, the Federal Government, on June 14, 1943, through the Civil Aeronautics Administration appropriated $600,000 for the development of the site including grading, drainage, runways, taxiways, taxiway pavements, aprons, turfing, and fencing, and in March, 1944, increased the allotment of $1,450,000. The plans and specifications for the improvement, prepared in the summer and fall of 1943 in the regional office of the CAA in Chicago, called for a Class IV airport, which will make it, when finally finished, one of the best equipped in the State,- a field capable of handling any type of land-based planes now being built. The grading and drainage work and the construction of the runways and pavements were begun in May, 1944, and were largely completed by the end of that year. There are three concrete runways each 5,360 feet long and a turfed runway 4,000 feet long, all 150 feet wide. In addition, there are about 12,000 lineal feet of taxiways paved with concrete, all 50 feet wide.

During the latter part of the summer of 1945, the University procured from the Defense Plant Corporation of the U.S. Government a metal hangar that had been used for training purposes at the Army air base near Grady, Arkansas. The building 100 by 360 feet in size, was reconstructed on the grounds here and opened in time fo for the ceremonial exercises which marked the dedication of the Airport on October 26. The 30-foot control tower on the structure makes it possible to use the airfield prior to the construction of the administration building.

In addition to furnishing another means of transport for the benefit of the local community as well as for those connected with the University or visiting the University, those responsible for the establishment of the airport saw in such action an opportunity for almost unlimited service to the whole State and the Nation. Foremost of the objectives was to provide educational facilities for training a supply of young personnel for positions requiring a basic knowledge of the engineering principles involved in the design, production, and operation of commercial aircraft engaged in both domestic and foreign service; in the design, construction, and operation of airports and airport facilities; and in the work of research conducted by commercial and government laboratories. Another objective was to implement a training program designed to benefit those teachers who were giving aviation instruction in the secondary schools and in other educational centers of the State to meet whatever eventualities the progressive experiences of an air-minded nation might evolve. Still another objective was to provide an opportunity for a limited amount of pilot training for resident students under responsible direction of the Reserve Officers Training Corps or the Civil Aeronautics Administration for positions in military or commercial service A further objective was to provide facilities that could be used by the several colleges of the University organization either alone or in cooperation with commercial enterprises or government agencies, to carry on extensive research programs of vital interest to those individuals or organizations that are associated in any capacity with the aviation industry. This would include practically every college on the Urbana campus and certainly the college of Medicine in Chicago.

In order to coordinate these several phases of work which the University might undertake, the Board of Trustees in November, 1945, established the Institute of Aeronautics to be administered under the supervision of a director who would have about the same status as a dean of a college and would report directly to the President.

E. STUDENT CENTER AND UNION BUILDING

The Illini Student Center.- In 1938, the University took over the building occupied at first by the Y. M. C. A. and later by the Illinois Union, at Wright and John Streets in Champaign, and remodelled it for a Student Center. As such, it contained the offices of the Illinois Union, the Alumni Association, the Star Course, and the Athletic Association, and rooms on the upper floors for student study and dormitory purposes. The Daily Illini occupied the basement. When the new Illini Union Building was completed in 1940, the name of the Student Center Building was changed to Illini Hall. It has continued, however, to provide accommodations for some student-activity and other offices, to serve as a residence hall for men, and to house the Daily Illini publishing plant.

The Illini Union Building.- The Illini Union Building constructed by the University in 1939-40 and operated by it without profit, is a well-appointed five-story, colonial structure, serving to create an environment appropriate for inspiring a common understanding and a spirit of friendship between students, faculty, and alumni, regardless of race or creed; for here the many barriers which often tend to exist between groups are broken down into a feeling of mutual understanding and fellowship. It has met the situation by becoming a social, cultural, recreational, and service center for student and other activities on the campus. The building itself designed on a generous scale provides space for the meeting places of student organizations, the offices of the Alumni Association and the University of Illinois Foundation, dining rooms and a cafeteria, a soda fountain, game rooms, air-conditioned bowling alleys, faculty and student lounges, general offices for the sale of tickets to University events, and a ball room that has accommodations for several hundred persons at a dance, banquet, or other assembly. In addition, there is a browsing room containing a well-planned library of about 2,000 books that provides a wholesome place for relaxation during the spare moments while enjoying the latest fiction, biography, and other literary production. There, too, is a music room, where a program supervised by a student

faculty committee, is presented daily from selections of the world's finest music.[1]

"The Illini Union Building completed in 1941 as a center of democratic student government, is the culmination of the hopes and dreams of the early administrators."[2]

The opening of the Building "had a broad influence on student life by providing recreational and dining facilities which were previously available to students only under commercial management and frequently under disreputable conditions. The pleasures of the students were made sources of profit to the community. It is easy to see why the profit-seeking interests so vigorously opposed the erection of this center. It is quite as easy to see also why their chief interest, as long as the center did not exist, lay in the profits they could make rather than in the excellence of the services they could give.

"The opportunities provided in this center, with its library browsing room, its center of art, its amusement rooms, its dining rooms, and its cafeteria, are a far cry from the conditions existing previously, and have inevitably led to an improvement in the morals as well as the morale of the student body."[3]

F. MEN'S RESIDENCE HALLS

Men's Residence Halls of Dormitories.- While the University has maintained a series of residence halls for women students for a number of years, it was not until the opening of the school year in September, 1941, that it was able to offer similar accommodations to men students. The halls assigned to men are composed of three modern buildings of colonial architecture, connected by passageways, containing 151 rooms suitable for two persons and 67 for one.

That these buildings have served a wholesome purpose is indicated by the following observations of a group of disinterested investigators who stated that the erection of these buildings "was far more signicicant than the mere additional accommodations they provided, might imply. Previous to the opening of the Men's dormitories, the University found it exceedingly difficult to set up and maintain minimum standards to be met by the rooming houses in order for them to be placed on the approved list of the University. The opening of the

1. From your first year at Illinois, page 40
2. Illio, 1943, page 278.
3. The University of Illinois Survey Report by a Commission of the American Council on Education, 1943, page 55.

dormitories provided these standards and gave a leverage for their enforcement. Thus, the provision of University residences for men resulted in a general improvement of living conditions in the entire community."[1]

G. TWIN-CITY TRANSPORTATION FACILITIES THROUGH THE CAMPUS

Urbana and Champaign Horse Railroad Service. The Urbana and Champaign Horse Railroad Company chartered in 1863, began the operation of a mule-powered line between Urbana and Champaign about 1866. The route ran over what is now Western Avenue from Urbana to Mathews Avenue, then continued on west through the campus to Wright Street, then straight ahead to Third Street in Champaign. At that point, it turned northwest to go across Scott Park and on to First Street, then it went north to the old Doane House which stood east of the Illinois Central tracks on the north side of Main Street. The stone arch which still stands near the northwest corner of Second and Springfield over a branch of the Boneyard, marks one of the points on the line of this old route. The car barns were located in Urbana directly east of the place where the county jail now stands. The company was taken over by the Urbana and Champaign Street Railway Company in 1883, which continued to operate the line in this manner for the next seven or eight years, after which it built an electric line between the Twin Cities, as described briefly in the next paragraph.

Urbana and Champaign Street Railway Service.[2] The route chosen by the Urbana and Champaign Street Railway Company to replace the old horse-car line began at Hill and Neil Streets in the Champaign business district, and extended south on Neil to Main Street, east on Main Street to Walnut Street, South on Walnut to University Avenue, east on University Avenue to Wright Street, south on Wright to Green, and east on Green to a point about opposite University Hall. The first cars to be operated by electric power over this line were run on October 20, 1890. Passengers bound for Urbana transferred at Wright Street and the old

1. University of Illinois Survey Report by a Commission of the American Council on Education, 1943, page 54.

2. Information regarding the first-part of this description was obtained from the Champaign County Gazette.

right of way to horse cars. The line provided twenty-minute service. The equipment including rolling stock and overhead power transmission were supplied by the Westinghouse Electric and Manufacturing Company. The Champaign end of the line was extended to the Big Four and Wabash tracks during October and November of that same year.

After some bickering over franchise problems, the Company extended its line east on Green Street to Goodwin Avenue, then turned north on Goodwin to the old right of way of the horse railroad company, then east over this old route to the Urbana business section, the first cars being run into Urbana on March 19, 1891. Within a comparatively short time, the Company built an alternative route that left University Avenue at Third Street, went south on Third to John Street, then east on John to Wright Street, then north on Wright to join the other route on Green Street. The small open shelter building now standing on the south side of Green Street opposite Burrill Avenue and known as the half-way house, was built by the University in 1893 as a waiting room for persons using the street-car line. The building stood originally on the north side of the street; but when plans were made to tear down the structure at the time the car line was discontinued, the alumni made such a protest that the house was preserved and moved to its present site. In 1895, when Green Street was paved, the track between Wright and Goodwin was moved to the north parking. The name of the corporation was changed in 1897 to the Urbana and Champaign Railway, Gas, and Electric Company.

In 1903-04, the line from Urbana was extended west from Goodwin over the original right of way of the horse railroad across the campus to connect with the Wright Street line in order to handle the interurban cars which began operation at that time between Champaign and Danville. After a number of years, the line was continued west from Wright Street over the old right of way of the horse railroad to third Street, and the interurban cars used this route into Champaign. In 1908, the Oregon Streetroute was constructed, entering the campus immediately south of the Chemistry Building and extending west to Wright Street, then north to connect with the other line. In 1909, the Green Street tracks were removed, partly to relieve

disturbances caused at the Physics Building, and partly to comply with the contract permitting the construction of the Oregon Street line across the campus. At the same time, the line from Urbana over the old right of way was double-tracked east of Burrill Avenue, for it was necessary to provide the additional tracks to maintain proper schedules for both local and interurban service.

All of these lines continued to supply transportation services to and through the University district for a number of years. However, other forms of transport, principally the automobile and city bus, gradually came into being and findlly superceded them, bringing about their removal. The Oregon Street, John Street, and Wright Street lines were taken up about 1930, and the Short Line, the route over the old right-of-way, was discontinued about 1940,—all routes giving way to city bus service.

Champaign-Urbana City Lines, Inc.— Bus service was established over practically the same routes as the street-car lines when the car-line service was discontinued, and has been maintained to the present time, the Champaign-Urbana Lines, Inc., operating three routes between the Twin Cities through the campus district,—two lines crossing the campus area on Green Street and one on Springfield Avenue. This type of service is much better than that which it supplanted, causing less noise and providing more comfortable service for the University Community.

CHAPTER XXI

LIBRARIES AND LIBRARY MATERIALS

A. CENTRAL, MAIN, OR GENERAL UNIVERSITY LIBRARY

Early Library Facilities.- Within a very short time after its opening, the University began to maintain a Central, Main, or General Library, which contained some books and periodicals relating to subjects in engineering. This General Library and its attending Reading Room were first located in a small room on the second floor of the Old University Building on University Avenue, there being about 5,000 volumes in all subjects in 1870. When University Hall was completed in 1873, the General Library was transferred to the third floor of the west wing of that building where it was assigned to a room 61 by 77 feet in size.

The University Catalogue and Circular of 1889-90 stated in regard to the General Library: "The library, selected with reference to the literary and scientific studies required in the several courses, includes about 19,000 volumes, and addition are made every year.

"The large library hall fitted up as a reading room, is open throughout the day for study, reading, and consulting authorities. It is intended that the use of the library shall largely supplement the class-room instruction in all departments. Constant reference is made in classes to works contained in the library, and their study is encouraged or required. The reading room is well provided with American, English, French, and German papers and periodicals, embracing some of the most important publications in science and art."

The same Circular and Catalogue gave in addition, a list of periodicals regularly received at that time, which included the following technical publications of special interest to engineers: Builder (London), American Engineer, Transactions of the American Society of Civil Engineers, Engineering News, Scientific American, Scientific American Supplement, Electrician (London), Engineering and Building Record, School of Mines Quarterly, Car and Locomotive Builder, American Architect, American Machinist, Western Manufacturer, Gazette of the Patent Office, Mechanics,

Locomotive, and American Artisan.

"The library itself, had its beginning in a tiny room behind the regent's office. At that time it was necessary for each student to have a signed order from his Professor in order to remove a book from the home-made shelves. Once inside the Library, men sat on the east side of the room, while the women were herded to the west side. Student mail was filed alphabetically in a corner rack."[1]

In 1896-97 a special library building was erected (Now Altgeld Hall) and this housed the University Library until 1924-25, when the first unit of the present Library was erected.

General Library Facilities Extended.- The following table gives the number of volumes which the University has had at various times since the beginning:

TABLE XXI- NUMBER OF VOLUMES IN THE UNIVERSITY LIBRARY, 1868-1944

Year	Volumes
1868-69	1,092
69-70	3,646
73-74	10,000
79-80	12,550
89-90	19,000
95-96	28,200
00-01	47,074
05-06	83,136
10-11	180,371
15-16	348,220
20-21	480,253
25-26	683,328
30-31	900,000
35-36	1,011,938
40-41	1,265,000
42-43	1,306,560

On June 30, 1944, the library had, in addition to its 1,351,432 volumes of books, 412 manuscripts, 393,830 pamphlets, 4772 catalogued maps, and 16,071 pieces of sheet music.

For a number of years, the University of Illinois Library has ranked fifth among the largest of educational institutions,-only Harvard, Yale, Columbia, and Chicago exceeding it in the number of volumes,-and first among the state universities and colleges.

1. Illinois Alumni N_ews, April 7, 1943, page 10.

B. ENGINEERING LIBRARIES

General.- In the early days of the University there were no formal college or departmental libraries, since there were comparatively few books, and no duplicates in the General University Library, and since it was thought the books were more useful in the General Library than distributed around the campus. Gradually, however, to meet the particular needs, small informal collections of books began to be accumulated at a few points about the campus, principally in the offices of departments, for at that time, the various buildings were so crowded that it was difficult or impossible to find a separate room for a departmental library; and besides the finances of the University would not permit the employment of any one to have charge of the books and magazines.

In 1894, at the time of the opening of Engineering Hall, there was established a semblance of an engineering library in Room 301, adjacent to the office of the Dean of the College. The reading room as it was then called, contained the computing instruments and other similar apparatus that belonged to the College in general. This equipment included a Thomas' 10-place arithmometer, an Amsler's integrator, Coradis rolling and radial planimeters, a large pantograph, numerous tables, and other aids in computations, many of which had been used when the College was located in University Hall.[1]

With the lapse of time and the gradual improvement of the financial status of the University, and with new buildings providing more room for the College purposes, rather substantial collections of books, periodicals, and other engineering materials began to be brought together in the various offices and departmental reading rooms of the College and in the General University Library, for it was recognized even in the early days that there was no instructional facility that could be of greater value to the undergraduate as well as the more advanced students and the faculty, than a good library.

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1. The Technograph, 1894-95, page 172.

As early as 1915, as the result of the accumulations, the General Library, began to be so congested with books and students that there developed the idea that the College of Engineering should have a central library of its own, under its own control. Accordingly, plans were developed, and after some agitation and some discouragement, the College obtained authority in the spring of 1916 to proceed with the establishment of such a library. The place chosen for the location of the library was on the first floor of the north wing of Engineering Hall. Considerable remodelling, of course, was necessary to transform this wing into suitable quarters for library purposes.

In March, 1916, the partitions separating the six rooms and the hallway under the large lecture room were removed, and within a short time the entire section was converted from classrooms, instrument rooms, laboratories, and offices into one light, airy, comfortable room, conveniently located for student and faculty use. The room was provided with tables, chairs, and suitable lighting facilities, affording accommodations for nearly 100 readers, and with steel stacks sufficient to house several thousand volumes of books and periodicals.

At that time, the departments of Civil Engineering, Mechanical Engineering, Municipal and Sanitary Engineering, and Electrical Engineering joined forces in bringing the materials from their departmental collections into the new library, although the department of Electrical Engineering retained a considerable number of volumes in its own building for use there. The departments of Railway Engineering and Mining Engineering retained their separate reading room in the Transportation Building, sending only a few volumes from their collection to the Engineering Library.

On September 18, 1916, the library [1] opened its doors with a collection of about 2,000 volumes on various engineering subjects, a small collection of reference books, a nucleus of a good collection of engineering handbooks, and 50 current

1. Some of the materials in this and the following two paragraphs were taken from the January, 1918, Vol. XXXII, issue of the Technograph,—an article by Elsie Louise Baechtold entitled "The Engineering Library", pages 106-108.

engineering periodicals. Most of this material had been transferred from the Main or General Library, and was arranged according to the General Library classification. It was made available to all students and faculty; and during the first eight months, the library staff cared for the needs of 36,000 patrons.

At the end of the first school year, there had been collected about 6,000 volumes, besides those still in the Railway and Mining Engineering Library in the Transportation Building. These included many handbooks, engineering and other encyclopedias including the Encyclopedia Brittanica and the New International, society publications, state and city publications,-books on all engineering subjects and a good collection of bound periodicals. There were more than 800 manufacturing catalogues, about 1,500 lantern slides, and 200 current periodicals. During the year the north corridor, 30 feet in length, had been made a part of the library space and was used for exhibit purposes, and it was found necessary to double the stack capacit to provide for the growing collection of books.

The establishment of the engineering library was a long step in advance over previous conditions, because it offered a more comfortable place for the students to read and study and greatly increased their use of books and technical journals.

As time went on, however, the Library became so overcrowded with students, books, and periodicals, that in 1931, the assembly room on the second floor immediately above it, originally used as the Physics lecture room, and three other small rooms adjacent were converted into additional library space, forming one large main room and one small study or conference room. Two stairways were provided to make this upper floor accessible from the first floor main-library room. This second floor is now occupied with bound periodicals and student study tables. The total seating capacity of both floors of the Library in 1945 is 210 students, including several individual study tables for faculty members and graduate students.

In 1945, the Library contains about 50,000 volumes, including textbooks and hand-books of American and foreign production, bound volumes of magazines of American and foreign issue, and publications and journals of all the major engineering

societies and practically all of the minor societies of this country and abroad, and is continually being enlarged on a progressive scale. It contains a complete file of the bulletins issued by the University Engineering Experiment Station and of the stations of most of the other colleges and universities of this country. It has a long list of bulletins and documents published by the Federal Government on subjects of engineering interest. It has also a large collection of biographical sketches of engineers and of early books on engineering. Its collections of early books on mechanics and strength of materials, on railways, and on the telephone and telegraph are considered by some to be among the best in the country. It has a small collection of books for general reading, including a collection of "engineering fiction", of popular books in science, and of books on vocational guidance along engineering lines. Each year, important books and sets on engineering in foreign languages as well as in the English language are added to the Library. There is an excellent collection of general technical dictionaries in the several foreign languages, with definitions in English, as well as similar dictionaries in the special fields of engineering. Approximately 500 technical and other publications of engineering societies are currently received, most of the sets of which are complete from the beginning.

The Ockerson collection of books on River Improvement, which was a part of the private library of the late John A. Ockerson of the Class of 1873, was presented to the University of Illinois by Mrs. Ockerson in 1924, and is housed in the Engineering Library.

To aid in reference and research work, the Engineering Library has complete sets of the Engineering Index, the Industrial Arts Index, Bibliographic Index, Highway-Research Abstracts, Japanese Journal of Engineering Abstracts, International Bibliography of Engineering and Industry, Chemical Abstracts, Science Abstracts, Building-Science Abstracts, Engineering Abstracts, Public Health Engineering Abstracts, Road Abstracts, Summary of Current Literature on Water Pollution Research, and Zentrallblatt fur Mechanik, as well as indexes to individual sets of magazines, publications of societies, and other series. Many other

bibliographical aids in related fields are in the Main University Library.

To assist the work in connection with classroom assignments, one complete section of the stacks in the Engineering Library is used for reserve books set aside for reference purposes.

One feature of the College Library that has always been very popular with the students has been the collection of books on biography, natural history, travel, fiction, ethics, poetry, etc., that has been maintained on the shelves or on open tables available for student use. Occassionally, special collections pertaining to particular topics, such as in 1924-25, "The Early Days of the Telegraph", have been borrowed from the General Library for display here. The Library has maintained for some time, exhibits of small specimens of museum materials loaned by departments or members of the faculty from their own collections.

Much engineering material, in addition, is housed in the University General Library, including old editions of books and much original matter, such as the original studies and computations of the Chicago Association of Commerce Committee of Investigation on Smoke Abatement and Electrification of Railway Terminals in Chicago, the final report in bound form being kept in the Engineering Library. Many of the engineering publications issued by state, federal, and foreign governments are also in the University Library.

The Library is now or has been supplemented by several specialized, or departmental libraries, of a scientific and engineering nature. Notably among these are the libraries in Ceramic Engineering, Railway and Mining Engineering, Chemistry and Chemical Engineering, Physics, Electrical Engineering, and Mathematics, some of which are described later in this chapter.

Library hours have always been arranged for student convenience. During the School year, the hours have been from 7:50 in the morning until 10:00 at night. At other times the hours are generally from 8:00 to 12:00 in the forenoon and from 1:00 to 5:00 in the afternoon. Reserve books may be taken out over night, but must be returned by 9:00 the next morning. Other books are subject to loans for two week at a time.

It is impossible to overemphasize the value of a central library to an educational institution. As well attempt to operate a machine shop without an adequate supply of tools as to carry on instructional and experimental work without a comprehensive library. Its study rooms provide sympathetic and harmonious surroundings for undivided attention to the subjects at hand and its literature serves to keep the students and faculty abreast of the times, although most faculty members, of course, receive regularly their own copies of professional journals and magazines. Its worth for reference in connection with the classroom and laboratory assignments and with research under way by graduate students and faculty is incalculable. As it has been developed from time to time throughout the years, the College of Engineering Library has gone a long way in meeting the needs which such an establishment should be able to supply.

C. ENGINEERING LIBRARY PERSONNEL

General.- The College of Engineering has been fortunate in the selection of personnel assigned to conduct the work of the Engineering Library. At all times during the year especially when school is in session, there have been well-trained attendants at the loan desk or otherwise available, to serve the needs of the College body. Brief biographies of those in charge are recorded in the following notes.

Elsie Louise Baechtold.- Librarian of the Engineering Library at the time of its opening in 1916, received the A.B. degree from Grinnell College in 1911. She served as Library Assistant at Grinnell during 1912-13, and Library Assistant at the University of Illinois during 1913-16, receiving the B.L.S. degree here in 1916. She remained in charge of the Engineering Library here until August, 1919, when she resigned to accept a position in the Technical Branch of the Los Angeles Public Library. Later, she had other appointments, but passed away at her home in Denver, Colorado, on April 28, 1937.

Hilda Josephine Alseth came to the University in 1918 and served as Assistant Librarian in the Engineering Library during 1918-19. When Miss Baechtold resigned

in 1919, Miss Alseth became Librarian of the Engineering Library and has served in that capacity to date. She received the A. B. degree from Yankton College in 1926 and the B.L.S. at the University of Illinois in 1927, having for several years carried her classroom work in the Library School in addition to her Engineering Library duties.

Student Assistants.- During the school year when the Library is open fourteen hours a day except Sunday, it is necessary to have the help of student assistants. Many of these assistants have been chosen from registrants in the College of Engineering, although some have been from other schools or colleges.

D. DEPARTMENTAL LIBRARIES AND SEMINARIES

General.- In the very early days of the University, the departments began to set up seminaries that contained some periodicals devoted to work along their special lines. Even as far back as when the College of Engineering occupied University Hall, this custom prevailed. It was continued when the College moved into its new quarters in Engineering Hall in 1894, where each department was provided with a seminary room for its particular needs. The method of the seminary system was to furnish the student references in standard engineering publications and from these he was required to gather information on some particular topic. In some departments, weekly meetings were held in the seminary room for the discussion of technical literature. In each of these rooms were kept on file all of the leading American and foreign technical journals pertaining to the work of the department.[1]

Out of the seminary system developed the plan of a departmental library,- the Department of Architecture being about the first to establish such a library with others following suit , including the Departments of Ceramic Engineering, Mining and Metallurgical Engineering, Electrical Engineering, Railway Engineering, and Physics. Some descriptions of these libraries follow in the next few pages.

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1. "The College of Engineering", by W. R. Morrison, '95, and P. Junkersfeld, '95, in the Technograph, Vol. 9, 1894-95.

Architectural Library.- Much of the money that other departments would ordinarily have spent for laboratory equipment, went towards the building up of the departmental library in architecture, for the library constitutes the working center in every architectural department. A University Circular[1] issued in 1908-09 carried the following statement in this connection: "Unlike engineering, architecture is able to utilize the excellent ideas in design produced during past ages; therefore, the most important and indispensable part of the equipment of a department of architecture is a good library containing full illustrations of the best monuments of the great historical styles. To make such a collection of books requires many years of careful collection, avoiding useless and inferior materials, but including the basal treatises on the principal architectural styles, especially those containing the latest results of excavations and other researches. The careful examination of the ruins of an ancient temple or a palace may entirely change the well-settled belief of our ancestors, when everything was comfortably decided beyond the reach of criticism. The client of an architect may demand a villa in Grecian, Gothic, French Renaissance, or even in one of the more unusual styles. Hence the necessity for the student to acquaint himself with the spirit and forms of all important styles in order to apply them to modern purpose".

Consistently from time to time, since the Department was established, there was added to the collection, the best standard works in English, French, and German, carefully selected for their usefulness in history and design, a vast amount of material for tracings, the productions in competitive designs, the latest books, and a complete file of the most important periodicals and professional journals. Throughout the years, every effort was made to keep it abreast of the times and to maintain its position as one of the outstanding libraries of its kind in the country. A rather complete description of its history is given in the chapter entitled "The Department of Architecture".

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1. U. of I, Circular of Information of the College of Engineering, Vol. V, June 15, 1908, No. 29.

Railway and Mining Engineering Library.- The Railway and Mining Engineering Library containing about 1,000 volumes was installed in Room 202, Transportation Building, in November[1], 1914. The room was open from 8:00 a.m. until 6:00 p.m., but there was an attendant present only during one hour a day. Because of obvious difficulties involved in this arrangement, the library was discontinued, and in May, 1918, the room was given up. A few of the railway books were placed in the departmental office in 101 Transportation Building, but most of them were transferred to the Engineering Library in Engineering Hall. Many of the mining books were taken to the departmental office at 208 Transportation Building, and the rest were removed to the Engineering Library.

Physics Library.- When the Department of Physics moved into its new building in 1909, it set aside Room 201 adjacent to the departmental office on the second floor for library and seminar use, and has continued to use it for that purpose to date. The books, including texts, encyclopedias, dictionaries, and other reference publications kept there, are for advanced study by students majoring in Physics and for reference use by members of the teaching and research staff. Approximately 75 current periodicals in English, French, and German, are received by the library, the bound volumes of which are filed there for reference use. Altogether, about 4,100 volumes are assigned to this library.

Electrical Engineering Library.- At the time of its organization, the Department of Electrical Engineering began to maintain a small reference library in its seminary room for the use of students and faculty members. When the Department moved into its building on Burrill Avenue, it set aside one room as a reading room for the Electrical Engineering Society. Throughout the years, following the Department continued to maintain one room in this building as a library for the convenience of the students and faculty interested with this particular line of engineering until June, 1934, when it turned its collection over to the Engineering Library.

1. The date of the opening was November 11.

Ceramic Engineering Library.- From the time the Department of Ceramics was organized in 1905, it began to accumulate books of ceramic interest for the use of its student and the members of the teaching staff. By the time the Department joined the College of Engineering, the collection had grown to rather substantial proportions; and when it moved into its new building on Goodwin Avenue, it assigned a room somewhat adjacent to the departmental office for the use of the Library and Reading Room. Later, it shifted its offices so as to provide an adjoining room for the purpose. Besides the 1,000 volumes of textbooks on hand in 1945, the Department receives about 37 current periodicals and journals that pertain to the ceramics industry. Bound volumes of these periodicals are kept on file also for reference use in connection with class and laboratory assignments as well as for research purposes. Altogether, in 1945, the Ceramic Engineering Library contains approximately 2,500 volumes dealing with subjects in ceramics and the phases of physical, chemical, and geological sciences that are vital for study in this particular field of engineering.

E. TEXTBOOKS

Early-Day Blueprint Textbooks.- The most serious obstacle that confronted the early instructors in the College of Engineering was the utter lack of textbooks in many of the subjects they sought to present. The best texts available would now be considered intolerably poor; but in several important subjects, particularly in mechanical engineering and architecture, there were absolutely no textbooks. Further, if memory is not in error, during the time here under consideration none of the many present-day methods of duplicating manuscripts had been invented, except that in 1878 the blueprint process came into use. In an attempt to meet the lack of textbooks, Professor Ricker and Professor Baker in the summer of 1879 with their own hands fitted up a room in the basement of University Hall (then known as the Main University Building) as a blueprint photographic laboratory, and made the necessary trestles, exposure frames, dark rooms, tanks, and drying frames for taking sun-prints of lecture notes. Also during that summer, each transcribed for

blueprinting several series of lecture notes already on hand. Professor Ricker typed his on detail paper, and Professor Baker wrote his long-hand on parchment tracing paper. Later, a student made blueprings of these sheets and sold them to the students.

In the course of three or four years the blueprint laboratory was annually printing and selling to engineering students 25,000 to 30,000 pages of lecture notes. Subsequent editions of some of these lecture notes ultimately were published as textbooks in other institutions in this and other countries. Ultimately other methods of reproducing lecture notes were invented, and new textbooks were published, and hence the blueprint laboratory was abandoned,--none too soon for the safety of the students' eyes. However, the blueprint textbook was an important factor in the early history of the College of Engineering.

List of Textbooks Written by Members of the Engineering Faculty.- The standard of work done by an educational institution is measured, in part at least, by the record of publications, specially of textbooks produced by its faculty. The members of the faculty of the College of Engineering here have written probably more textbooks than those of any other engineering faculty in the country. The following list gives the names of the authors and co-authors, arranged alphabetically by departments, the titles of the texts, the dates of printing, and the names of the publishers. A few of the books were written before the authors joined the staff at the University. A few, also, were published after the authors left the University, but in such instances, much of the materials for the manuscripts were prepared while the writers were connected with the University. In the main, though, books written by authors after they left the University are not included in the list.

Many of these texts have had a wide acceptance among the engineering schools of the land, and have been extensively read by men engaged in professional service.

a. ARCHITECTURE

Newlin Dolbey Morgan

"Continuous Frames of Reinforced Concrete", with Hardy Cross, published by John Wiley & Sons in 1932.

Rexford Newcomb[1]

"The Franciscan Mission Architecture of Alta California", Published by The Architectural Book Publishing Company in 1916.

"Old Mission Churches and Historic Houses of California", published by J.B. Lippincott Company in 1925.

"The Spanish House for America", published by J.B. Lippincott Company in 1927.

"Mediterranean Domestic Architecture in the United States," published by J. H. Jansen in 1928.

"In the Lincoln Country", published by J. B. Lippincott Company in 1928.

"Outlines of the History of Architecture", published in four parts by John Wiley and Sons during 1922-39.

Home Architecture" with W. A. Foster, published by John Wiley and Sons in 1932.

Nathan Clifford Ricker

"Elementary Graphical Statics and Construction of Trussed Roofs", published by W. T. Comstock in 1885; third edition in 1892.

"A Treatise on Design and Construction of Roofs", published by John Wiley and Sons in 1912.

"Simplified Formulas and Tables for Floors, Joists and Beams; Roofs, Rafters and Purlins" published by John Wiley and Sons in 1913.

William Sidney Wolfe

"Graphical Analysis", published by McGraw-Hill Book Company in 1921.

b. CERAMIC ENGINEERING

Andrew Irving Andrews

"Ceramic Tests and Calculations", published by John Wiley & Sons in 1928.

"Enamels", published by the Twin City Publishing Company, Champaign, in 1935.

"Enamel Laboratory Manual", with Ralph L. Cook, published by The Garrard Press, Champaign, in 1941.

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1. Professor Newcomb wrote several books after 1931 that are not contained in this list.

Ralph Le Verne Cook

"Enamel Laboratory Manual", with Andrew Irving Andrews, published by the Garrard Press, Champaign, in 1941.

Edward Wight Washburn

"Introduction to the Principles of Physical Chemistry", Published by McGraw Hill Book Company in 1915; second edition in 1921.

c. CIVIL ENGINEERING

Harold Eaton Babbitt

"Sewerage and Sewage Treatment", published by John Wiley & Sons in 1924.

"Plumbing", published by McGraw-Hill Book Company in 1928.

"Water Supply Engineering" with J. J. Doland, published by McGraw-Hill Book Company in 1929; third edition in 1939.

"Water Supply and Purification", Section X of Civil Engineers' Hand-Book, published by McGraw-Hill Book Company in 1934.

Ira Osborne Baker

"Leveling; Barometric, Trigonometric, and Spirit", published by D. Van Nostrand Company in 1886; fourth edition in 1918. Republished in French in 1912.

"A Treatise on Masonry Construction" by John Wiley and Sons in 1889; tenth edition in 1920.

"Engineers' Surveying Instruments,-their Construction, Adjustment, and Use", published by John Wiley and Sons in 1892; second edition in 1915.

"A Treatise on Roads and Pavements", published by John Wiley and Sons in 1903; third edition in 1918.

Edward Ezra Bauer

"Plain Concrete", published by McGraw-Hill Book Company in 1928; second edition in 1936.

"Highway Materials", published by McGraw-Hill Book Company in 1928; second edition in 1932.

John Stanley Crandell

Chapter on "Highway Engineering" in the American Civil Engineer's Pocketbook, published by John Wiley & Sons in 1930.

Hardy Cross

"Continuous Frames of Reinforced Concrete", with N. D. Morgan, published by John Wiley & Sons in 1932.

Chapters X, XIV, XV, and XIX, of Kidder's Architect's and Building Handbook.

Raymond Earl Davis

"Manual of Surveying for Field and Office", published by McGraw Hill Book Company in 1915; second edition in 1928.

James Joseph Doland

"Water Supply Engineering", with H.E.Babbitt, published by McGraw Hill Book Company 1929; third edition in 1939.

Chapter 15, "General Engineering Handbook", published by McGraw-Hill Book Co, 1932.

Whitney Clark Huntington

"Building Construction", published by John Wiley & Sons, 1929, second edition 1941

Milo Smith Ketchum

"Surveying Manual", with W.D.Pence, published by McGraw-Hill Book Company in 1900; fifth edition in 1932.

"Design of Steel Mill Buildings", published by McGraw-Hill Book Company in 1903; fifth edition in 1932.

"Design of Walls, Bins, and Grain Elevators", published by McGraw-Hill Book company in 1907; third edition in 1918.

"Design of Highway Bridges of Steel, Timber and Concrete", published by McGraw-Hill Book company in 1908; second edition in 1920.

"Design of Mine Structures", published by McGraw-Hill Book Company in 1912.

"Structural Engineers' Handbook", published by McGraw Hill Book Company in 1914; third edition in 1924.

"Stresses in Framed Structures; Part I of Design of Steel Mill Buildings", published by McGraw-Hill Book Company in 1932.

Everett Edgar King, See Railway Engineering, Chapter XV.

Albert Boyer McDaniel

"Excavating Machinery", published by McGraw-Hill Book Company in 1913.

"Earthwork, Parts I and II", published by the American School of Correspondence in 1915.

William D. Pence

"Surveying Manual", with M.S.Ketchum, published by McGraw-Hill Book Company in 1900; fifth edition in 1932.

Charles Wesley Malcolm

"Elements of Graphic Statics", published by The Author, 1907; revised, 1912.

Frederick Haynes Newell

"Water Supply for Irrigation", published by Government Printing Office in 1894.

"Irrigation in the United States", published by T.Y.Crowell & Company in 1902; second edition in 1906.

"Principles of Irrigation Engineering", with D.W. Murphy, published by McGraw-Hill Book Company in 1913.

"Irrigation Management", published by D. Appleton & Company in 1916.

"Engineering as a Career" with C.E.Drayer, published by D.Van Nostrand Company in 1916.

"Water Resources, present and future Uses", published by the Yale University Press in 1920.

"Planning and Building the City of Washington", published by the Washington Society of Engineers and edited by Dr. Newell, 1932.

George Wellington Pickels

"Railroad Surveying", with C.C.Wiley, published by John Wiley & Sons in 1913.

"Drainage and Flood-Control Engineering", published by McGraw-Hill Book Company in 1925; second edition in 1941.

"Land Drainage in Illinois", Bulletin No.42 (revised) of the Illinois Geological Survey.

"Route Surveying", with C.C.Wiley, published by John Wiley & Sons in 1930; second edition in 1939.

William Horace Rayner

"Surveying," with R.E.Davis and F.S.Foote, published by McGraw-Hill Book Company in 1928.

"Elements of Surveying" with R.E.Davis and F.S.Foote, published by McGraw-Hill Book Company in 1930.

"Surveying", published by D.Van Nostrand Company in 1937.

"Advanced Surveying", published by D.Van Nostrand Company in 1941.

Frank Berry Sanborn

"Mechanics Problems for Engineering Students", published by The Engineering News Publishing Company in 1902; second edition by John Wiley and Sons in 1906.

Jerome Sondericker

"Notes on Graphic Statics", published by John Wiley and Sons in 1903.

Thomas Clark Shedd

"Theory of Simple Structures", with J.Vawter, published by John Wiley & Sons in 1931; second edition in 1941.

"Structural Design in Steel", published by John Wiley & Sons in 1934.

Frank Whitworth Stubbs

"Estimates and Cost of Construction", published by John Wiley & Sons in 1938.

Karl Terzaghi

"Morphologie and Hydrographie des Kroatischen Karstes", published in Budapest in 1913.

"Erdbaumechanik", published in Vienna in 1925.

"Ingenieurgeologie", co-author, published in 1929.

"Theorie der Setzung von Tonschichten", co-author, published in Vienna in 1936.

"Erdbaumechanik und Baupraxis, co-author, published in 1937.

"Theoretical Soil Mechanics", published by John Wiley & Sons in 1943.

Jamison Vawter

"Theory of Simple Structures", with T.C.Shedd, published by John Wiley & Sons in 1931; second edition in 1941.

Leslie Abram Waterbury

"A Vest Pocket Handbook of Mathematics", published by John Wiley and Sons in 1908; third edition in 1919.

"Cement Laboratory Manual", published by John Wiley and Sons in 1908.

"Laboratory Manual for the Use of Students", published by John Wiley & Sons in 191[illegible].

Carroll Carson Wiley

"Railroad Surveying", with G.W.Pickels, published by John Wiley & Sons in 1913.

"Route Surveying", with G.W.Pickels, published by John Wiley & Sons in 1930; Second edition in 1939.

"Principles of Highway Engineering", published by McGraw-Hill Book Company in 1928; second edition in 1935.

Clement Clarence Williams

"Design of Railway Location", published by John Wiley & Sons in 1917; second edition in 1924.

"Design of Masonry Structures and Foundations", published by McGraw-Hill Book Company in 1922; second edition in 1930.

"Building an Engineering Career", published by McGraw-Hill Book Company in 1934.

Wilbur M. Wilson

Section on "Statically Indeterminate Stresses" in Hool and Kinne's Stresses in Framed Structures, published by McGraw-Hill Book Company in 1923.

d. ELECTRICAL ENGINEERING

Ernst Julius Berg

"Electrical Energy, its Generation, Transmission, and Utilization", published by McGraw-Hill Book Company in 1908.

Hugh Alexander Brown

"Radio-Frequency Electrical Measurements", published by McGraw-Hill Book Company in 1931; second edition in 1938.

William Esty

"Elements of Electrical Engineering" Vol I, 1906, and Vol II, 1907, with W.S. Franklin, published by the MacMillan Company.

"Dynamo Laboratory Manual" with W.S.Franklin, C.E.Clewell, and S.S.Seyfeit, published by the MacMillan Company in 1908.

"Dynamos and Motors" with W.S.Franklin published by the MacMillan Company in 1909.

"Alternating Current Machinery" published by the American Correspondence Schools in 1912.

William Lyttell Everitt

"Communication Engineering", published by McGraw-Hill Book Company in 1932; second edition in 1937.

"Fundamentals of Radio", With E.C.Jordan, published by Prentice Hall, Inc. in 1942.

Section on Telephony and Telegraphy in the Standard Handbook for Electrical Engine

Max Albert Faucett

"Machines in Electrical Engineering", with J.O.Kraehenbuehl, published by John S. Swift Company in 1937.

"Circuits in Electrical Engineering", with J.O.Kraehenbuehl, published by John S. Swift Company in 1935; second edition, 1937.

"Circuits and Machines in Electrical Engineering", with J. O. Kraehenbuehl, published by John Wiley & Sons in 1939.

Gilbert Howard Fett

"Introduction to Circuit Analysis", with A.B.Knight, published by Stipes publishing Company, Champaign, in 1939, and by Harper & Brothers in 1943.

Edward Conrad Jordan

"Fundamentals of Radio", with W.L.Everitt, published by Prentice Hall, inc., in 1942.

Abner Richard Knight

"Introduction to Circuit Analysis", with G.H.Fett, published by Stipes publishing Company, Champaign, in 1939, and by Harper & Brothers in 1943.

John Otto Kraehenbuehl

"Machines in Electrical Engineering", with M.A.Faucett, published by John S. Swift Company in 1937.

"Circuits in Electrical Engineering", with M.A.Faucett, published by John S. Swift Company in 1935; second edition in 1937.

"Circuits and Machines in Electrical Engineering", with M.A.Faucett, published by John Wiley and Sons in 1939.

"Electrical Illumination", published by John S. Swift Company in 1940, and by John Wiley and Sons in 1942.

Herbert Joseph Reich

"Theory and Application of Electron Tubes", published by McGraw-Hill Book Company in 1939.

"Principles of Electron Tubes", published by McGraw-Hill Book Company in 1941.

"Ultra-High Frequency Techniques", with J.G. Brainerd, Glenn Koehler, and L.F. Woodruff, published by D.Van Nostrand Company in 1942.

Carl Eric Skroder

"Laboratory Analysis of Direct-Current Machines", published by Edward Brothers in 1941.

John Kline Tuthill, See Railway Engineering, Chapter XV

c. GENERAL ENGINEERING DRAWING

Randolph Philip Hoelscher

"Teaching Mechanical Drawing", published by John Wiley and Sons in 1929.

"Engineering Drawing", with H.H.Jordan, published by John Wiley and Sons in 1923; third edition in 1935.

"Basic Units in Mechanical Drawing", with A.B.Mays, published by John Wiley and Sons, Book I in 1933; second edition in 1941; Book II in 1934.

"Essentials of Drafting", with Clifford H. Springer, published by the Illini Union Bookstore, Champaign, in 1942.

"Industrial Production Illustration for Students, Draftsmen, and Illustrators", with C.H.Springer and R.F. Pohle, published by McGraw-Hill Book Company in 194[illegible].

Harvey Herbert Jordan

"Descriptive Geometry", with F.M.Porter, published by Ginn & Company in 1929

"Engineering Drawing", with R.P.Hoelscher, published by John Wiley & Sons in 1923; third edition in 1935.

"Engineering; a Career, a Culture", published by Engineering Foundation in 1932.

James Thoburn Lendrum

"Architectural Projections", with F.M.Porter, published by John S.Swift Co. in 1935

Harry Willard Miller

"Mechanical Drafting", published by Manual Arts Press, Peoria, in 1915; revised 1919.

"Descriptive Geometry", 1915; revised 1918 and published by John Wiley & Sons; seventh edition, 1941.

Francis Marion Porter

"Mechanical Drafting", published by Manual Arts Press, Peoria in 1915.

"Descriptive Geometry", with H.H.Jordan, published by Ginn and Company in 1929.

"Architectural Projections", with J.T. Lendrum, published by John S. Swift Company in 1935.

Clifford Harry Springer

"Essentials of Engineering Drafting", with R.P.Hoelscher, published by Illini Union Bookstore, Champaign, in 1942.

"Industrial Production Illustration for Students, Draftsmen, and Illustrators", with R.P. Hoelscher and R.F. Pohle, published by McGraw-Hill Book Co. in 1943.

f. MECHANICAL ENGINEERING

Bruce Willet Benedict

"Railway Shop Up-to-Date", with M.H. Haig, published by the Railway Master Mechanic in 1907.

"Betterment Briefs", published by Crane and Company, Topeka, Kansas, in 1908. (Mr. Benedict was editor of this book.)

Carl Herbert Casberg

"Shop School Administration", with A.B. Mays, published by Bruce Publishing Co. in 19[illegible]

Edward Jameson Crane

"Mechanics of Machinery", with C.W. Ham, published by McGraw-Hill Book Company, 1927; second edition in 1938.

Howard Edward Degler

"Steam, Air, and Gas Power", with W.H. Severns, published by John Wiley & Sons in 1929, Third edition in 1939.

George A. Goodenough

"First Course in Calculus", with E.J. Townsend, published by H. Holt & Company in 1907.

"Essentials of Calculus", with E.J. Townsend, published by H. Holt & Company in 1910.

"Principles of Thermodynamics", published by H. Holt & Company in 1911; third edition in 1920.

"Properities of Steam and Ammonia", published by John Wiley & Sons in 1915; second edition in 1917.

Chapter on Thermodynamics in the American Civil Engineers handbook.

William Freeman Myrick Goss

"Bench Work in Wood", published by Ginn and Company in 1890.

"Locomotive Sparks", published by John Wiley and Sons in 1902.

"Locomotive Performance", published by John Wiley and Sons in 1907.

"High Steam Pressure in Locomotive Service", published by Carnegie Institution of Washington, in 1907.

"Superheated Steam in Locomotive Service", published by Carnegie Institution of Washington in 1910.

"Smoke Abatement and Electrification of Railway Terminals in Chicago" published by Rand, McNally and Company, in 1915.

Clarence Walter Ham

"Mechanics of Machinery", with E.J. Crane, published by McGraw-Hill Book Company in 1927; second edition in 1938.

Section on "Pipe and Pipe Fittings" in Mark's Mechanical Engineers Handbook, published by McGraw-Hill Book Company in 1930.

Louis Allen Harding

"Mechanical Equipment of Buildings", Vol. I, "Heating and Ventilation", and Vol. II, "Power Plants and Refrigeration", with A.C. Willard, published by John Wiley and Sons in 1916; second edition in 1929.

"Heating, Ventilating, and Air-Conditioning", also with A.C.Willard, published by John Wiley and Sons in 1916; second edition revised in 1932.

Oscar Adolph Leutwiler

"Elements of Machine Design", published by McGraw-Hill Book Company in 1917.

"Problems in Machine Design", published by McGraw-Hill Book Company in 1923.

Horace James Macintire

"Mechanical Refrigeration", published by John Wiley and Sons in 1914

"Principles of Mechanical Refrigeration", published by McGraw-Hill Book Company in 1922; second edition in 1928.

"Handbook of Mechanical Refrigeration", published by John Wiley & Sons in 1928.

"Section on Refrigeration in American Society of Refrigerator Engineering Data Book, 1932.

Chapter on Refrigeration in General Engineering Handbook, 1932

"Refrigeration Engineering", published by John Wiley and Sons in 1937; revised printing in 1940.

Joseph Albert Polson

"Internal Combustion Engines", published by John Wiley & Sons in 1931; second edition in 1942.

Carl Edward Schubert

"Manual of Foundry Practice", with A.D.Wright and J.F.Woodell, published by the Bloomington Pantagraph in 1934.

"Foundry Practice", published by John S.Swift Company in 1941.

William Harrison Severns

"Steam, Air, and Gas Power", with H.E.Degler, published by John Wiley & Sons in 1929; third edition in 1939.

"Heating, Ventilating, and Air-Conditioning Fundamentals", published by John Wiley and Sons in 1937.

Arthur Cutts Willard

"Mechanical Equipment of Buildings", Vol.I, "Heating and Ventilation", and Vol.II, "Power Plants and Refrigeration", with L.A.Harding, published by John Wiley and Sons in 1916; second edition in 1929.

"Heating, Ventilating, and Air-Conditioning", also with L.A.Harding, published by John Wiley & Sons in 1916; second edition in 1932.

John Frank Woodell

"Manual of Foundry Practice", with C.E.Schubert and A.D.Wright, published by The Bloomington Pantagraph in 1934.

Arthur Tannant Woods

"Elementary Mechanism", with A.W.Stahl, published by D.Van Nostrand in 1885.

"Compound Locomotives", published by D.Van Nostrand Company in 1891.

Amos David Wright

Manual of "Foundry Practice", with C. E. Schubert and J. F. Woodell, published by the Bloomington Pantagraph in 1934.

Everett Gilham Young. See Railway Engineering.

g. Mining and Metallurgy

Arthur Joseph Hoskins

"The Business of Mining", published by J. B. Lippincott Company in 1912.

Harry Harkness Stoek

"Economic History of Anthracite", part of "Economic Histroy of the United States", published by Carnegie Institution of Washington, D.C.

"The Pennsylvania Anthracite Coal Field", in Twenty-Second Annual Report of the U.S. Geological Survey, 1900-01.

h. Physics

Albert Pruden Carman

Section on "Electricity and Magnetism" in Alexander W. Duff's "Physics for Students of Science and Engineering", published by J. Blakiston's Son and Company in 1908; sixth edition in 1926. 1/

Charles Tobias Knipp

"Conduction of Electricity through Gases" in Alexander W. Duff's "Physics for Students of Science and Engineering", published by J. Blakiston's Son and Company in sixth edition in 1926. 1/

Jakob Kunz

"Theoretische Physik auf Mechanischer Grundlage", published by F. Enke in 1907.

"Theories of Magnetism", with others, Bulletin No. 18 of the National Research Council, published by the National Research Council in 1922.

Translation of part of Volume III of Helmholtz's "Physiological Optics", published by the Optical Society of America in 1925.

Francis Wheeler Loomis

"Molecular Spectra in Gases", with others, published by the National Research Council in second edition in 1930.

Robert Frederick Paton

"Physics for Colleges", with Sheldon, Kent, and Miller, published by D. Van Nostrand Company in 1925; second edition in 1926.

1/ These two sections by Professors Carman and Knipp were combined in the seventh edition, 1932.

William Frederick Schulz

"Manual of Experiments in General Physics, published by D. Van Nostrand Co. in 1932.

Floyd Rowe Watson

"Acoustics of Buildings", published by John Wiley & Sons in 1923; second edition in 1930.

Chapter 35, Acoustics of Buildings in Kidder-Parker "Architects and Builders Handbook" in 1931.

Alonzo Morris Buck

"The Electric Railway", published by the McGraw-Hill Book Company in 1915.

Everett Edgar King

"Railway Singaling", published by McGraw-Hill Book Company in 1921.

Shelby Saufley Roberts

"Track Formulae and Tables", published by John Wiley & Sons in 1910.

Edward Charles Schmidt

Section on Railway Engineering in Mechanical Engineers' Handbook, published by McGraw-Hill Book Company.

John Kline Tuthill

"Transit Engineering", published by John S.Swift & Company in 1935.

Everett Gilham Young

"Railway Mechanical Engineering", published by Ming Chang Press, Shanghai, China, in 1923.

j. THEORETICAL AND APPLIED MECHANICS

Jasper Owen Draffin

"Strength of Materials", published by John Wiley & Sons in 1928.

Chapter in H.F.Moore's "A Text-book of Materials of Engineering", fourth edition published by McGraw-Hill book Company in 1930; sixth edition in 1941.

"The Story of Man's Quest for Water", published by the Garrard Press, Champaign, in 1939.

Melvin Lorenius Enger

"Hydraulics", published by the International Text-Book Company.

Newton Edward Ensign

"Analytical Mechanics for Engineers", with F.B.Seely, published by John Wiley & Sons in 1921; third edition in 1941.

Herbert Fisher Moore

"A Textbook of Materials of Engineering", published by McGraw-Hill Book Company in 1917; sixth edition in 1941.

"The Fatigue of Metals", with J.B.Kommers, published by McGraw-Hill Book Company in 1927.

"Manual of the Endurance of Metals under Repeated Stress", published by Engineering Foundation in 1927.

Section VII of Merriman's Civil Engineer's Handbook, published by John Wiley & Sons in Fourth edition, 1920, and fifth edition in 1930.

Harvey Ellison Murdock

"Strength of Materials", published by John Wiley & Sons in 1911.

Fred B. Seely

"Analytical Mechanics for Engineers", with N.E. Ensign, published by John Wiley & Sons in 1921; third edition in 1941.

"Resistance of Materials", published by John Wiley & Sons in 1925; second edition in 1935.

"Advanced Mechanics of Materials", published by John Wiley & Sons in 1932.

Arthur Newell Talbot

"The Railway Transition Spiral", published by McGraw-Hill Book Company in 1899; sixth edition in 1927.

CHAPTER XXII

EVOLUTION OF ENGINEERING COURSES AND CURRICULA

General.- The gradual evolution of the curricula during the various stages in the development of the several departments in the College of Engineering during the last three-quarters of a century, represents the combined opinion and judgment of the teaching staff in the light of its own experiences and the recommendations of professional groups, to keep pace with the demands imposed by changing conditions in industrial practice, for practically every field of engineering science has constantly expanded as society has grown more complex and involved. The presentations that follow outline only a few of the main steps in this development, for it is impossible to include all the progressive changes that have been made during this period of educational advancement.

A. COURSES AND CURRICULA FROM 1868 to 1900

a. FIRST CURRICULA[1] IN THE FOUR ORIGINAL DEPARTMENTS

Courses and Curricula at the Opening of the University.- At the beginning of the University, all subjects were elective; for two years no set curricula were established, although the courses and curricula of study at several other institutions including Rennselear Polytechnic Institute, Massachusetts Institute of Technology, and University of Michigan were printed in the University Catalogue and Circular as "suggestions to students". In 1869-70, however, fairly definite four-year courses of study in Mechanical and Civil Engineering were "recommended". The Catalogue and Circular (as it was then called) of 1871-72 listed definite arrangements of the four engineering curricula in Mechanical Engineering, Civil Engineering, Mining Engineering and Metallurgy, and Architecture and Fine Arts as provided by the action of the Board of Trustees. The University Catalogue and Circular of 1872-73 contained the following descriptive materials and the four

1. It is of interest to note that the word curriculum in common usage today, seldom appeared in the Annual Register until 1916-17.

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curricula in engineering listed in the order given below.[1]

School of Mechanical Engineering
First Year[2]

1.[3] Solid Geometry, 7 weeks, and Algebra, 7 weeks; Descriptive Geometry and Drawing, 10;[4] English or French; History, 2.

2. Advanced Algebra; Free-hand Drawing, 10; English or French; History, 2.

3. Plane and Spherical Trigonometry; Free-hand Drawing, 10; English or French; History 2.

Second Year

1. Designing and Drawing, 10; Advanced Descriptive Geometry; German.

2. Shop Practice and Drawing, 10; Analytical Geometry; German.

3. Shop Practice, 10; Calculus; German.

Third Year

1. Principles of Mechanism; Calculus; Principles of Chemistry; Vacation Journal and Memoir.

2. Analytical Mechanics; Physics; Shades, Shadows, and Perspective, 10.

3. Analytical Mechanics, 3; Descriptive Astronomy, 4; Physics; Chemistry Laboratory Practice, 10.

Fourth Year

1. Hydraulics, 1, Thermodynamics and Pneumatics, 4; Resistance of Materials, Trusses; Geology or Mental Philosophy; Vacation Journal and Memoir.

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1. In all issues of the University catalogues up to and including 1893-94, the curricula were listed in the following order: Mechanical Engineering, (Electrical Engineering after its adoption in 1890), Civil Engineering, (Municipal and Sanitary Engineering after its adoption in 1892), Mining Engineering until it was dropped in 1893), and Architecture. In 1894-95 and later issues, they were listed alphabetically.
2. The school year was divided into three terms of 14, 12, and 10 weeks respectively.
3. Term
4. Thenumber following the subject indicates the number of hours a week required in the course. Unless otherwise designated, the students met one hour each school day.

2. Prime Movers, Millwork; Finished Machine Drawings, 10; History of Civilization.

3. Millwork and Machines; Designs and Estimates, 10; Political Economy; Thesis.

Vacation Journal and Memoirs[1]

"Journals of Travel are required to be kept during summer vacations. Entries should be made as often as once a week, and consist of notices of Manufactories, especially of their peculiar mechanical methods and machines. Dimensions of large or important machinery, such as stationary engines of water works, blowing or hoisting engines, and machinery in use in mining or other operations, may form a part of the record. The Journals of the first Vacation are to be read and discussed in connection with the class in Designing and Shop Practice, and those of the second in connection with the Class in Cinematics and Principles of Mechanism. They should be illustrated by sketches reproduced upon the blackboard.

"Reports of Memoirs upon visits and observations of the third vacation, will be required instead of journals, to be read in the class in Machine Drawing during the middle term of the fourth year.

"These reports should be made upon rare and interesting mechanical operations or machinery, such as making gas pipe, spinning zinc, copper and brass ware, manufacturing saws, etc. They will be placed in the Library of the School, and should be illustrated by ample sketches and drawings."

SCHOOL OF CIVIL ENGINEERING

OBJECT OF THE SCHOOL

"The School is designed to furnish a course of theoretical instruction, accompanied and illustrated by a large amount of practice, which will enable students to enter intelligently upon the various and important duties of the Engineer. Those who desire a preparation, at once broad and thorough, and who are willing to make persevering effort to obtain it, are cordially invited to connect themselves with this School".

COURSE OF STUDIES

"The Complete Course occupies four years........... The studies of the first three years will prepare students for undertaking many engineering operations, such as the building of railroads, canals, embankments, etc. The fourth year is intended to fit them for the higher Engineering constructions, as the building of arches, trussed bridges, and supporting frames of all kinds.

"Each year consists of thirty-six working weeks, divided into Fall, Winter and Spring terms,....... Each recitation requires one hour in the class room, and its preparation should be given an average time of three hours."

School of Civil Engineering

First Year

Same as Mechanical Engineering

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Second Year

1. Land Surveying and Drawing, 10; Advanced Descriptive Geometry; German.

2. Typographical and Right-line Drawing, 10; Analytical Geometry; German.

3. Topographical Surveying and Drawing, 10; Calculus; German.

Third Year

1. Railroad Surveying and Drawing, 10; Calculus; Principles of Chemistry; Vacation Journal and Memoir.

2. Analytical Mechanics; Physics; Shades, Shadows, and Perspective, 10.

3. Analytical Mechanics, 3; Descriptive Astronomy, 4; Physics; Chemical Laboratory Practice ,10.

Fourth Year

1. Hydraulics, 1, Practical Astronomy and Geodesy, 8; Resistance of Materials, Trusses; Geology or Mental Philosophy; Vacation Journal and Memoir.

2. Bridge Construction; Finished Engineering Drawings, 10; History of Civiliaation.

3. Stone Work, 8; Architectural Drawing, 8; Political Economy; Thesis.

Vacation Journals[1]

"Journals are required to be kept by each student during his second and third year vacations. They must be written as often as once a week, and will contain accounts of the travels and occupations, with special reference to matters pertaining to his chosen profession, and general attention to all scientific and industrial facts. They will be presented during the Fall terms, read before the Class, interesting facts discussed, and marked and credited as studies of the course.

"It is recommended that students employ their vacations in Engineering practice. To facilitate this important part of their preparation, students of creditable standing at the ends of the second and third years of their courses, can obtain certificates to this effect from the Professor in charge."

Projects and Vacation Memoirs

"During the Spring Term of the second year, an accurate Topographical Survey of a locality is made by the Class, with reference to the execution of a Project in Railroad Engineering, which is then given to the Class for consideration and discussion, but which is executed in the Fall Term of the next year. The Plane-table is used as in the U.S. Surveys.

"The Project consists of: Memoirs, Location, Drawings and Estimates.

"The Memoir will prepare a location for a railroad to fulfill certain exact requirements, and will state the reasons for the choice with the necessary

1. Pages 34-35.

calculations and estimates. It will be presented at the opening of the Fall Term. Different memoirs will be compared, and one or two routes decided upon for the class to work up.

"The Location will consist in running the line over the routes decided upon, with all the necessary measurements and calculations for establishing the grades, setting slope stakes, determining the amount of earth-work, designing the buildings, bridges, culverts, etc.

"The Drawings will include: Alignment, Profile, Plans, and Sections.

"The Estimates will give the cost of ground, earth-work, structures, rolling stock, etc.; expenses of operating the line and estimated income.

"A Memoir will also be required at the opening of the fourth year upon an allowed subject, and a Project in Engineering construction will be executed during the year."

School of Architecture

First Year

Same as Mechanical Engineering

Second Year

1. Joinery, and Detail Drawing, 10; Advanced Descriptive Geometry; German.
2. History of Architecture, Drawing, 10; Analytical Geometry; German.
3. Methods of Architecture, Drawing, 10; Calculus; German.

Third Year

1. History of Architecture, Drawing, 10; Calculus or Surveying; Principles of Chemistry.
2. History of Architecture, Drawing, 8; Analytical Mechanics; Shades, Shadows, and Perspective, 8.
3. History of Architecture, Drawing, 8; Crayon Drawing from Plates, 8; Mechanics and Astronomy, or Mineralogy.

Fourth Year

1. History of Architecture, Drawing, Crayon Drawing from Casts, 10; Resistance of Materials, Trusses; Geology or Mental Philosophy; Vacation Journal and Memoir.
2. Architectural Designing, 8; Complete Drawings, 8; Physics.
3. Specifications, Estimates, 8; Stone Work, 8; Physics; Thesis.

Vacation Journals and Memoirs

Some work was required in Journals and Memoirs in the Architectural curriculum, but not so much as in some of the other departments.

School of Mining Engineering

First Year

Same as Mechanical Engineering

Second Year

Same as Civil Engineering

Third Year

1. Railroad Surveying and Drawing, 10; Calculus; Principles of Chemistry; Vacation Journal and Memoir.
2. Analytical Mechanics; Physics; Chemical Laboratory Practice, 10.
3. Mineralogy and Crystallography; Physics; Descriptive Astronomy, 4, Chemical Laboratory Practice, 10.

Fourth Year

1. Hydraulics, 1, Practical Astronomy and Geodesy, 8; Chemical laboratory Practice, 10; Geology or Mental Philosophy; Vacation Journal and Memoir.
2. Assaying; Mining Engineering; Metallurgy.
3. Mining Drawing, 10; Metallurgy; Geology of Mining Districts; Thesis.

The General Arrangement of the Curricula.-In modeling the details of the first courses of study, the materials were planned then as now, to give the students a thorough training in the fundamental principles underlying all engineering generally and such added instruction in special lines as would enable them to meet the problems of some particular field,-an arrangement designed for insuring professional growth in the years ahead while preparing for positions in immediate service. As arranged, the primary and basic theoretical subjects as mathematics, physics, chemistry, elementary drawing, and descriptive geometry were all placed in the first two years or as early as possible in the instructional program, and the applied subjects in the last two years,-a practice that was borrowed from French Universities and one that is still maintained in all the curricula

of the College of Engineering not only in Illinois, but also in other engineering schools of the country. The advantages of teaching theory first and professional applications later is obvious, of course. In addition, this arrangement of standardization common to all schools simplified transfer where students were obliged to go from one department or one school to another. The requirements for graduation were thus rigidly fixed, there being little choice of subjects and no place for free electives in the several programs. Much emphasis was placed on mathematics then as now, not only for the mental training it provided within itself, but also because it furnished the foundation for the more advanced subjects.

That the faculty was keenly aware of the benefits to be derived from constructive and original writing, is evidenced by the requirement that each student had to prepare vacation journals and memoirs, describing some phase of the work with which he was connected during the summer period. As a further indication of the value which the faculty placed upon such documents, some of them, at least, were deposited in the University Library for reference use, for it must be remembered that not many textbooks were available for reference or study purposes in those days.

Thesis.-The first publication of definite courses of study, appearing in the University Catalogue and Circular of 1871-72, stated that a thesis was a requirement for graduation in engineering, but not in other colleges. No time was assigned for the preparation of the thesis; and therefore it became in fact an extra subject added to the regular curriculum of study. The Catalogue and Circular of 1873 carried the following statement regarding the subject of thesis:

> "In all the Schools of this College a Thesis is required of those who graduate. It must be an original composition of suitable length, upon a subject appropriate to the School, and approved by the Professor in charge. The student must be prepared to read, explain and defend it before his class. It must be illustrated with such photographs, drawings and sketches as may be needed, and embellished with a title page neatly designed and printed with India ink, or colors. It must be upon Regulation Paper and securely bound. It will be prepared during the latter part of the fourth year and presented at the close of the course, after which it will be deposited in the Library of the College."

The more competent and more ambitious students usually looked upon the thesis

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as a challenge to their attainments and also as an opportunity to test their power of independent work and original research; and many such students worked on their theses with well-directed energy and enthusiasm, particularly in the earliest history of the University when the number of students was so small that the contact between the instructor and the student was so intimate that it was comparatively easy for the former to interest the latter in some constructive problem. Parts of some of these theses were published in The Technograph, and some were embodied in textbooks prepared by members of the faculty. Although most of the theses were simply buried in the library, some of them deserved a better fate.[1]

b. THE EARLY CHANGES IN CURRICULA

Subsequent Changes in Early Engineering Curricula.-The outlines of the original curricula were not materially changed for twenty years, except that in 1873-74 a "review" of algrebra and geometry was dropped from the first term of the freshmen year, and except also that from time to time some technical subject was extended or a general subject dropped to make room for more professional work, as for example formal shop practice was added in the different curricula between 1877 and 1881.

Mathematics ran through the first two years. Part of the time French was included in the freshman year, and German in the sophomore; and part of the time French or German was optional, each for two years, and later the option was French, German, or English. Until 1886-87, analytical mechanics was taught in the last two terms of the junior year, and resistance of materials and hydraulics in the first term of the senior year; but after that date, all three were taught in successive terms in the junior year. From the beginning until 1890-91, all engineering seniors were required to take science, history of civilization or

1. The thesis requirement was continued from 1873 to 1913, a period of forty years, after which a thesis was made optional, and that only for high-grade students, which resulted in the practical discontinuance of undergraduate theses, as stated later. The requirement of a thesis was discontinued chiefly because of the large number of students,-The University could not supply the necessary facilities in laboratory, library, etc., nor furnish adequate supervision by an instructor.

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constitutional history, and political economy,--subjects taught by the Regent. From the beginning, the freshman-year work was common to all curricula; and in the sophomore and junior years, about one-third of the time was given to technical subjects, and in the senior year about two-thirds.

In 1891-92, themes and elocution were required of all engineers in the junior year, and thereafter rhetoric and themes in the sophomore year. Elementary geometric drawing was always in the first term of the freshman year; and most of the time elementary descriptive geometry was in the sophomore year, and advanced descriptive geometry in the junior year; but finally drawing and descriptive geometry became a unit running through the freshman year. Chemistry was given during the first two terms of the junior year. Until 1891-92 physics was taught the last two-thirds of the junior year; and thereafter during the entire sophomore year.

c. NEW CURRICULA

General.-The first signs of the expanding life of the College of Engineering did not appear until about twenty years after the opening of the University, for the field of engineering developed rather slowly in those days. As it did develop, however, the size of the staff was increased and new courses and curricula were added in proportion to keep abreast of the times. The first three of these curricula,--Electrical Engineering, Architectural Engineering, and Municipal and Sanitary Engineering,--are outlined in the following paragraphs.

ELECTRICAL ENGINEERING

The First Curriculum in Electrical Engineering.-Although no separate department of electrical engineering had yet been created, the first course of study in that particular field appeared in the 1890-91 Catalogue and Circular as follows:

"The University is now prepared to offer, as a second course in the Department of Mechanical Engineering, a full course of Electrical Engineering. The first two years of this course will be identical with those of Mechanical Engineering, which evidently furnishes the only rational foundation upon which an electrical course may be built. The mechanical course has already offered such an amount of instruction in electrical specialties as has enabled its graduates to take service promptly and efficiently in electrical work. A well equipped electrical laboratory will be open in the fall term, with dynamos, motors, batteries, and

all forms of instruments for the theoretical and practical discussion of the subject in all its phases, for measuring electric forces, and for testing electric apparatus".

COURSE IN ELECTRICAL ENGINEERING

Leading to the Degree of B. S.

"In the first and second years, this course is identical with the course in Mechanical Engineering."

THIRD YEAR

1. Analytical Mechanics; Chemistry; Mechanism. [illegible]
2. Resistance of Materials, Chemistry; Engineering Materials.
3. Mill Work; Hydraulics; Dynamo-Electric Machinery.

FOURTH YEAR

1. Mental Science; Heat Engines; Electric Measurements.
2. Constitutional History; Hydraulic Engines and Wind Wheels; Electrical Laboratory.
3. Political Economy, Electrical Transmission of Power; Electrical Laboratory.

After this first year, a full separate curriculum in electrical engineering not essentially different from the foregoing one, was offered by the Department of Physics, and was continued after the division became a department of its own.

The First Curriculum in Architectural Engineering.-The first course of study in Architectural Engineering appeared in the 1891-92 issue of the Catalogue as follows:

ARCHITECTURAL ENGINEERING

"The especial purpose of this course of study is to qualify graduates for the profession of architecture, and particularly as architects, structural draughtsmen, and computers, as well as superintendents of construction. It is intended for those students preferring the mathematical and structural side of architecture to the artistic side, and for those who wish to acquire a thorough knowledge of iron and steel construction as it is now executed in architectural structure."

ARCHITECTURAL ENGINEERING COURSE

FIRST YEAR

1. Advanced Algebra; Elements of Draughting; Shop Practice; French, German, or English; Military.

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2. Trigonometry; Descriptive Geometry and Lettering; Shop Practice; French, German, or English; Military.

3. Analytical Geometry; Advanced Descriptive Geometry; Shop Practice; French, German, or English; Military.

SECOND YEAR

1. Differential Calculus; Wood Construction; Physics; French, German, or Free-Hand (all optional); Military.

2. Advanced Analytical Geometry; Stone, Brick, and Metal Construction; Physics; French, German, or Free-Hand (all optional); Military.

3. Integral Calculus; Sanitary Construction; Physics; French, German, or Free-Hand (all optional); Military.

THIRD YEAR

1. Analytical Mechanics; Architectural Drawing; Chemistry; Themes and Elocution.

2. Resistance of Materials; History of Architecture; Architectural Drawing; Themes and Elocution.

3. Roofs; History of Architecture; Hydraulics; Themes and Elocution.

FOURTH YEAR

1. Masonry Construction; Superintendence, Estimates, and Specifications; Architectural Perspective, or Advanced Graphics.

2. Bridge Analysis; Heating and Ventilation; Architectural Design; Thesis.

3. Bridge Design; Surveying; Architectural Design; Thesis.

The First Curriculum in Municipal and Sanitary Engineering.-The first course of study in Municipal and Sanitary Engineering appeared in the 1891-92 Catalogue as follows:

MUNICIPAL AND SANITARY ENGINEERING

OBJECT

"This course is a modification of the civil engineering course and is designed for students intending to make a specialty of City Engineering work. It includes the study of chemistry and bacteriology necessary to a comprehension of the questions involved in water supply and sewage disposal."

COURSE IN MUNICIPAL ENGINEERING

COURSE IN MUNICIPAL ENGINEERING

FIRST YEAR

1. Advanced Algebra; Elements of Draughting; Shop Practice; French, German, or English; Military.
2. Trigonometry; Descriptive Geometry and Lettering; Shop Practice; French, German, or English; Military.
3. Analytical Geometry; Advanced Analytical Geometry; Shop Practice; French, German, or English; Military.

SECOND YEAR

1. Differential Calculus; Land Surveying; Physics; French or German (optional); Military.
2. Advanced Analytical Geometry; Topographic Drawing, and Transit Surveying and Leveling; Physics; French or German (optional); Military.
3. Integral Calculus; Topographic Surveying; Physics; French or German (optional); Military.

THIRD YEAR

1. Railroad Surveying; Analytical Mechanics; Chemistry; Themes and Elocution.
2. Railroad and Road Surveying; Resistance of Materials; Botany, one-half term; Steam Engineering, one-half term; Themes and Elocution.
3. Roofs; Hydraulics; Electrical Measurements; Themes and Elocution.

FOURTH YEAR

1. Water Supply Engineering; Masonry Construction; Bacteriology.
2. Sewerage; Bridge Construction; Chemistry.
3. Tunneling; Bridge Analysis; Chemistry.

<u>Builder's Course.</u> The Builder's Course, established in 1875, was discontinued in 1893, because the number asking for it was so small as not to justify the expenditure. The Catalogue and Circular of 1876-77[1] contained the following statement regarding this work:

"The Trustees allow persons desiring to fit themselves for Master Builders to take a course of a single year, pursuing such technical studies of the course in architecture as they may be prepared to enter upon with profit, and as will be most advantageous to them.

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"Candidates for the Builder's Course must pass the examinations in the common branches, but need not pass in the Studies for the Preliminary Year unless they shall desire to pursue studies other than those marked in the following:

1. Wood Construction, 10; Projection Geometry, 10; Shop Practice (Carpentry and Joinery), 10

2. Stone, Brick and Metal Construction, 10; Architectural Drawing, 10; Shop Practice (Stair Building), 10

3. Agreements, Specifications, Estimates, Heating, and Ventilation, Architectural Design, 10; Shop Practice (Cabinet Making), 10."

d. MECHANICAL ENGINEERING SHOP PRACTICE

General.-Reference is frequently made to a shop established almost as soon as instruction started, but this shop occupied much the same relation to the University that the farmer's tool-room does to the work of his farm. It consisted of a few carpenter's tools in a small room in a building partly occupied as a mule-stable. However, the Regent in his morning chapel talks frequently advised the studentstto learn to use carpenter tools, and at least a few did receive during the year 1868-69 some instruction in the use of the simpler carpenter tools; but it is now impossible to obtain any definite information as to the character and scope of such work, but in all probability the instruction thus given was negligible.

On January 10, 1870, only ten days after his appointment as Head of the Department of Mechanical Engineering, Professor Robinson appeared before the Board of Trustees and presented a communication in which he forcibly stated his recommendations for equipping a shop to give students practical instruction and outlined his methods of accomplishing this, for shopwork, especially in metals, seemed naturally to fall to mechanical engineering. He seems to have clearly understood the importance of combining theoretical and practical instruction, "especially for mechanical engineering students"; but he contemplated more than the making of skilled mechanics, since he clearly intimated that the student should design the machine, make the patterns, mould them, cast the parts, and finish them. He proposed to employ the students in making illustrative models for the University and for sale, thus furnishing the desirable practical instruction and

incidentally a profitable application of student labor.

To carry out his plan, Professor Robinson asked for $2 000 with which to equip a shop, a very large sum considering the state of education and the condition of the University's finances; but apparently the Board recognized that the newly-elected professor was a man of force who had definite ideas about the subject in hand, and promptly granted the appropriation and ordered shop work in mechanical engineering to begin. Besides, the plan proposed by Professor Robinson was more than welcome because the student labor system, which was set up shortly after the University had opened, had failed for lack of work, much to the dismay of the Regent and other officials.

Operations began when the lower story of a 24 by 30-foot wooden building, then standing at the southeast corner of Wright Street and Springfield Avenue, and occupied jointly as a mule stable and as a carpenters' shop, was assigned as a machine shop. The mules were driven out, and the carpenter tools were moved to a second story added for that purpose. A steam boiler, an engine lathe, a forge, vises, a few hand tools, and the partly-finished castings for a steam engine were purchased; and Professor Robinson with the help of his students proceded to make a 10-horse power steam[1] engine which had some novel features to adopt it to experimental purposes. Mr. Alexander Thomson, a civil-engineering graduate of the University of Michigan and a skilled worker in metal and wood, was employed as foreman of the shop. It is significant to note that much of the lathe work of finishing the steam engine was done by turning the lathe by hand, the students, the foreman, and the professor taking turns in pulling the belt.

On March 8, less than two months after Professor Robinson presented his first report, the Regent stated to the Trustees that "the steam engine had been completed, and much enthusiasm is exhibited by the students of this department, some of whom are already making original drawings for machines, and learning to make foundry patterns".

1. This the first steam engine made by Professor Robinson and his students.

Thus began the first distinctly educational shop in America. The University of Illinois and Professor Robinson have never received the credit due for this pioneer work in educational shop practice. At that time the only other institution giving shop work was the Worcester (Mass.) Polytechnic Institute, which began shop practice November 12, 1868; but in neither quality nor scope was that work equal to that which Professor Robinson immediately inaugurated at the University of Illinois; for the controlling motive at Worcester seems to have been to produce articles for sale, while here the dominating idea was to use the shop practice to prepare the student to become a mechanical designer. Not infrequently, the Massachusetts Institute of Technology, which was opened for students in 1865, is credited with giving the first educational shop practice in this country; but it does not appear that any one in authority ever claimed this credit for the Institute. In the holiday vacation of 1876-77 Dr. J. D. Runkle, then President of the Massachusetts Institute of Technology, visited the University of Illinois to study its system of shop practice. Probably because of the absence from the University of those better acquainted with such work the writer (Professor Baker, who had never worked in the shop nor had any part in its administration), was requested by Regent Gregory to explain the system of shop practice to Doctor Runkle. This assignment required an entire day in the shops. Apparently, President Runkle came to inspect the shop work of the University of Illinois because he had seen its exhibit of work at the Centennial Exposition at Philadelphia the preceding summer. At that time it did not appear that the Institute was giving any shop work; but it did offer a thorough course the fall following, i.e. in 1877.

The method of shop practice adopted would at present be classed as the apprentice system. During the first two years of the shop's history, the students made several illustrative models of novel mechanical movements, some of which were invented by Professor Robinson. They also made numerous pieces of apparatus for class illustration in physics. Perhaps the most noted product of the shop during this time was an authmatically-directed heliscope for the "United States Lake Survey," and a chronograph for the laboratory of physics.

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It is very remarkable that so soon after the establishment of this meagerly-equipped shop, work of such high quality could be turned out, and particularly that students, few or none of whom had had any training in machine-shop practice and most of whom had had but little academic preparation, could do even any part of such work. In July, 1870, the writer (Professor Baker) visited the University to see whether or not he should become a student of the new institution; and by far the most impressive thing he saw was the absorbing interest and magnetic enthusiasm of, say, a half dozen students (all strangers to him) who were spending their vacation working in the machine shop. It was their opinion that they were engaged in a work that would be of great benefit to themselves, and that the institution, or more particularly the Mechanical Engineering Department was destined to revolutionize the college educational system of the country. Doubtless they had reached this conclusion partly through the frequent eloquent addresses of Regent Gregory at the daily chapel exercises, and partly from the recognized ability and contagious enthusiasm of Professor Robinson; but it is safe to assume that no thought of his being engaged in an industrial or educationalrevolutionary movement ever entered the head of the modest professor. For several years the confidence and zeal which centered in the work of the machine shop was one of the most potent influences about the young institution for the up-building of not only the machine shop and the Department of Mechanical Engineering, but also of the entire University, as has already been explained.[1]

In a little more than a year after the opening of this small shop, the legislature appropriated $25,000 for a new mechanical and military building, which is the strongest evidence of the approval by the public and the University authorities of the methods of instruction employed by Professor Robinson. This building, which was known as the Mechanical Building and Drill Hall and which

1. It is interesting to note that this shop, early after it was established, so impressed Mr. Chauncey Rose of Terre Haute, Indiana, as to change his intentions as to the disposal of his fortune, and to cause him to establish and endow Rose Polytechnic Institute at Terre Haute (Report of Board of Trustees of University of Illinois, 1888, p. 206)

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stood at the corner of Burrill and Springfield Avenues, was occupied early in the fall of 1871, the west half, except for a recitation room in the northwest tower, was used for the machine and pattern shop, and the east half, except for an artillery room in the northeast tower, was used for the University repairshop. A small sum of money was spent for additional tools to supplement those transferred from the original shop, but the allowance was entirely inadequate in consideration of the magnificent work already accomplished. At this time Mr. E. A. Robinson became Foreman of the Shop in place of Mr. Thomson, who resigned to accept a college teaching position elsewhere.

The most noteworthy feature of the equipment of the new shop was a 35[1]-horse-power steam engine, designed by Professor Robinson and his students in the drafting room and made by the latter in the old shop. The most interesting characteristics of this engine were an extremely heavy piston scientifically designed so that the momentum of the reciprocating parts was completely absorbed by the compression in the cylinder; a fly-wheel accurately designed to be in balance with the heavy piston;[2] a peculiar and efficient valve-operating mechanism, which in ten or fifteen years afterwards was adopted and successfully used by a large and prominent engine builder; a steam-jacketed cylinder cast in a single piece; a provision for taking steam-indicator cards; and a brake. All the University went to the shop "to see Robinson harness his new engine", make brake tests, and take indicator cards. This engine supplied power for the shops for twenty-five years, when it was taken out to make way for electric motors.

The main purpose of the shop was to train mechanical-engineering students in the use of hand and machine tools; and it is interesting to note the degree of skill developed in inexperienced students, even though they were engaged in such practice only a few hours a day. The work was always under the immediate direction

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1. This is the second Engine built by Professor Robinson and his students.
2. As a result of his study for the design of this engine, Professor Robinson shortly thereafter published a masterly paper on the proper relations between the weight of a piston and the size and weight of a fly-wheel of a steam engine.

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of a skilled and conscientious foreman who was in hearty sympathy with the undertaking. Besides, Professor Robinson, himself, was always in intimate personal contact with the student workers, always to instruct, encourage, and commend. Another factor that contributed towards the success of the program was the fact that many of the students were older and hence they were more appreciative of their opportunity and were better equipped for their work by greater maturity than the present college students. In addition, many of them came to the University with a real desire for mechanical training and technical knowledge. Perhaps the most important influence was the interest the students took in making tangible things, in seeing the work of their minds and hands develop into products of practical value. Experience at the University in after years, as will be discussed later, seems to prove that the last-mentioned factor was more important than was understood either at that time or during the next several years.

While from the very beginning, Professor Robinson seemed to have had a clear conception that the chief purpose of shop practice was to give practice in the manipulation of tools and to teach principles that would be valuable in the professional practice of the mechanical engineer, and not merely to afford remunerative labor to students, nevertheless, doubtless because of the traditions of the University and the desire of the administration to furnish labor for self-supporting students, he reluctantly permitted the machine shop to be used for the double purpose of giving educational practice and furnishing remunerative labor to students. From the time the Department of Mechanical Engineering was established, it had more applications for employment than it could meet; and as the Regent reported, it furnished more labor to students than all of the rest of the University combined.

As the reputation of the shop grew, there was great demand that it engage in the general repair of machinery. Farmers brought cultivators, corn shellers, mowing machines, threshing machines, portable engines, etc., to be repaired; and owners of grist mills, grain elevators, tile mills, and saw mills sought the help of the University machine shop when in trouble. The less-skilled students were employed

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in the repair of machinery, while those most skilled continued to make illustrative models and apparatus and to do the better commercial work. No record can be found of the products of the shop; but the following is a list of such things as can be recalled as having been made in the shop from 1871 to 1877: A system of steam heating for the public rooms in the then main University building (later usually referred to as the Old Dormitory); the steam heating system of the mechanical and military building, "at a great saving over the lowest bid;" a lawn mower for the University, when such machines were a novelty; a dozen microscope stands for the Department of Botany; a blowing engine for the ventilation of the old chemistry building; a 40-horse power engine to drive a flour mill in Chester, Illinois; a number of small machines for the shop, including a "pattern lathe" and a drill press"; great numbers of a vingette photographic printing frame; a tool and guides for trimming photographs to any size and form, invented by Professor Robinson, and advertised and sold in great numbers by a firm in Philadelphia; five successive and increasingly elaborate machines for automatically graduating the scale of thermometers, for the last of which Professor Robinson received an award at the Centennial Exposition in Philadelphia, and which form is still the only one in use in the world, although one of Professor Robinson's graduates, Mr. E. M. Burr, class '78 greatly improved Robinsons' latest form; a new type of lockstitch sewing machine having a continuous circular motion for the shuttle and a treadle without a dead point, which ran very easily and almost without any noise; an odontograph, a simple instrument by which gear teeth could be readily laid out scientifically,--an instrument invented by Professor Robinson and made in 25-lots by the shop, and one still in general use; and the University tower clock which is now in the Illinois Union tower and which contains two important elements which are both novel and simple, and which after more than seventy years of service have proven to be efficient. In addition, the foreman, E. A. Robinson, brother of Professor Robinson, made the following contributions: helped an inventor in perfecting the design for a corn sheller, and manufactured several of these machines--a type of machine still made by a prominent Illinois manufacturer; assisted an inventor in perfecting a power hay-fork, and then manufactured many dozens of them; assisted an inventor in perfecting a 12-inch well augur, and manufactured several dozens;

and helped a local inventor in perfecting the design and manufacture of what was probably the first elevating road-grader ever made.

In spite of all the arguments presented in favor of commercial work in the shops, Professor Robinson always felt that the conduct of such practice hindered the educational functions of the University and greatly increased the burden of general oversight.

e. ARCHITECTURAL SHOP PRACTICE

General.- While visiting the International Exposition at Vienna in the summer of 1873, Professor Ricker had been greatly impressed with an exhibition of shop work from the Imperial Technical School in Moscow, which consisted of a graded series of exercises from the most simple in hand and machine work in wood and metal, blacksmithing, pattern making, and foundry work, to a finished steam engine; and shortly after being placed in charge of the instruction in architecture, he introduced a system of shop practice suggested by the Russian system he had seen at Vienna. For a time this subject was listed in the catalogue as Joinery. Written instructions were given in the use of the several carpenter tools, and each student was required to make a series of specimens showing examples of sawing, planing, chiseling, moulding, in-laying, miter joint, mortise-and-tenon joint, dove-tail joint, etc. Later students were required to make to scale, models of dwellings, barns, etc;; and ultimately some of the most skillful students made scale models of stairs including the hand rail. For the first few years after the inauguaration of the architectural shop practice, the number of students in architecture was much smaller than that in mechanical engineering, and hence the work in the architectural shop did not bulk as large in University affairs as that in the mechanical-engineering shop. The architectural shop did not engage to any considerable extent in commercial work, although architectural students and others did assist in the construction of furniture and the repairs of buildings under the direction of Professor Ricker as Superintendent of the Carpenter Repair Shop.[1]

1. It is interesting to note that a member of the Board of Trustees who had been appointed to install the young professor in charge of the shop, discharged his mission by going to the shop with the professor and saying: "There it is. Now make the damned thing pay."

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Description of Courses in Architectural Shop Practice.-The Catalogue[1] of 1876-77 gave in some detail a description of the courses taken in architectural shop practice as follows:

"To give a practical knowledge of various kinds of work, and the proper mode of doing them, a full course of instruction is arranged of three terms, which all architectural students are required to pursue unless they have already had equivalent practice. The system is similar to the Russian system, so much admired at the Centennial Exposition, but more comprehensive, and applied to building rather than mechanical engineering. Tools, materials, and tuition are free of charge.

First Term -- Carpentry and Joinery

Sharpening Tools, Planing Flat Surfaces, at Right Angles, Uniform Width, and Thickness, Framing with Single Tenons, Double Tenons, Paneling, Splices, Dovetailing, Sticking Mouldings.

Second Term - - Cabinet Making and Stair Building

Paneling, Champers, Turning, Setting Locks and Hinges, Tree Sawing, Veneering, Buhl, Reissner, and Inlaid Work, Carving, Stairs, Hinges, Strings, Setting Balusters, Squaring and Moulding Rails.

Third Term - - Miscellaneous

Finishing in Shellac, Oil, Wax, and Varnish, Polishing, Painting, and Ornamenting, Gilding, Metal Work, Filing, Turning, Drilling, Cutting Screws, Ornamental Work, Casting Soft Metals, , Tempering.

Stone Work, in Plaster, Cutting Ashlar and Moulded Work, Rusticated Work, Venssotts for Arches, Domes, and Vaults, Carving, Relief, and Incised."

f. SHOP PRACTICE REORGANIZED

General.-In the summer of 1877, after long and anxious consideration by all concerned, the method of conducting the mechanical-engineering shop was radically changed. Commercial work was entirely discontinued, and a system of graded exercises was adopted to give the student skill in manipulating hand and machine tools. This involved practice in pattern-making, foundry-work, blacksmithing, bench work

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for iron, and machine-tool work for iron. These series[1] were worked out after the manner of the Russian system of shop practice introduced in 1873 in the architectural shop by Professor Ricker. With this change, shop practice was listed for the first time in the formal statement of the curriculum and found a place in the recitation schedule of all freshman engineering students.

These changes were made for three reasons: Mr. E. A. Robinson, the effective foreman, having been graduated in 1875 and therefore having accomplished that for which he came to college, had resigned to set up a machine shop for himself; the commercial work had developed to such an extent as to make it difficult to maintain the educational functions of the shop; and , some of the trustees and also others failed to distinguish between the educational and the commercial functions of the shops, and desired, and almost demanded, that the shop should be self-supporting. The growing institution had pressing and increasing needs for more money, and this intensified the feeling among some that the shop should be made to pay its own way. However, the discontinuance of all commercial work would help to establish in the minds of all the essential functions of the shops.

With this change Mr. E. A. Kimball, an unusually skillful mechanic and a cultivated gentleman, became foreman of the machine shop.

At the same time that these changes were made in the method of conducting the machine shop, and for the same reasons, similar changes were made in the architectural shop. The Russian system of shop practice had been in use in the architectural shop for four years, but the series of exercises were constantly extended; and[2] the time in the curriculum given to shop practice was increased from one term to three terms.

By gradual changes in the next few years, shop practice came to be listed as a required study during the entire freshman year in all the engineering curricula except mining; and this form of shop practice was continued in substantially all

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1. This series is briefly described on pages 31 and 32 of the University Catalogue for 1877-78.
2. This series is breifly described on page 41 of the catalogue for 1877-78.

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of the engineering curricula until 1913-14, except that in September, 1895, it was dropped from the curricula in architecture, when the architectural shop was merged into the mechanical-engineering shop.

For several years every one connected with the University believed that this type of shop practice was much superior to that formerly employed. The facilities for doing the work were much better than formerly, and the instruction was equally as competent and more extended; nevertheless the system failed to develop the interest and enthusiasm of the students as did the former system, and it is doubtful if the training provided as much skill and resourcefulness as the old plan.

Early Summer Session in Shop Practice Held in Chicago.- The following announcement appeared in 1878 on page 1 of a small printed pamphlet[1] with blueprint cover which showed University Hall on the front cover and the Mechanical Building and Drill Hall on the back cover:

Illinois Industrial University

Mechanic Art School

Summer Session

to be held in the

Exposition Building in Chicago

Eight Weeks

Under Charge of

Prof. S. W. Robinson, C.E.

Professor of Mechanical Engineering

and

Prof. N. Clifford Ricker, M.S.

Professor of Architecture

Commencing Monday June 24th

and closing August 15th

1. Now in the office of Historian.

Succeeding pages carried the following items explaining in some detail the instructional work involved:

"The School will be divided into two distinct departments or Schools as follows:

1. The School of Iron Working
2. The School of Wood Working

"The plan of this Session is novel, it being the first of its kind ever to be held in the west, if not in the country. It represents a new departure in education, demanded by the best interests of the manufacturing nations of the world. It teaches in a radical and systematic way the elements of mechanic art.

ADVANTAGES OF THIS SYSTEM[1]

"1. It provides a substitute for the old system of apprenticeship, now gone out of use. Modern manufacturers have replaced the skill of the mechanic by machinery, which an ordinary hand can learn to run in a few days. But breadth of skill and matured mechanical judgment are still required in superintendents and managers. These , the Mechanic Art Schools must supply.

2. Experience proves that the instruction of the Mechanic Art School is more than a substitute for the apprenticeship. It teaches quicker and better. Students, after a few times of practice, three hours per day, have become better workmen than was usual after as many years of the old apprenticeship drudgery.

3. It analyses mechanic processes into their simplest elements,-their alphabet, as it were,-and allows the mastery of one thing at a time. It aims not at construction, but at instruction. All of the elements being mastered, their combinations in construction being simple and intelligible.

4. The student while learning the mere technical processes, has also an opportunity to gain a liberal education in science at the same time.

ADVANTAGES OFFERED BY THIS SUMMER SESSION

"1. Coming in the vacation it offers opportunity for a pleasant employment of three hours a day of the long vacation time. To the tired student of the High School it will be a pleasant change and a safe diversion.

2. It will give to the diligent student the command of the tools, and the power to produce accurately and in a workmanlike manner, the various surfaces and forms required in wood and iron construction.

3. It has been proved by the experiments at the University as well as the Massachusetts Institute of Technology, that the 120 hours practice and instruction such as will be given in this summer Session, are equal to at least one Year's apprenticeship, and in some to three.

4. It will aid to give a practical turn to life, so often lost sight of in mere book studies and may powerfully influence and aid the future career of the student. A trade is a resource against misfortune, and a help and pleasure in prosperity.

5. To such as may desire afterwards to pursue a course in the College of Engineering and Architecute, this summer Session will count as a term of shop practice in the University course.

1. This refers to the advantages of the Russian as modified and used at the University here and as proposed for the Summer Session.

6. The training gained will enable the student in after years to judge of the workmanship of the furniture or machinery he wishes to purchase and of the house built for him."

In both iron and wood working, the classroom periods were from 9 to 12 in the forenoon for one section and from 2 to 5 in the afternoon for another, five days a week for the full eight weeks. Classes were limited to twelve students each thereby restricting the total enrollment to forty-eight,-twenty-four in iron and twenty-four in wood. The charge for each student was $25 for the 120 hours of instruction. The University supplied all of the materials and the benches and heavy tools and machines. Professor Robinson was in charge of the iron work and Professor Ricker of the wood work.

g. THE SEMESTER PLAN

General.- Until 1898-99, when the University adopted the semester plan, courses were scheduled for five recitations a week during one or more of the three terms of 14,12, and 10 weeks each respectively. After that time, however, classes were scheduled from one to five times a week during one or both semesters.

In spite of the work involved in shifting the calendar program from the term to the semester basis, there were several advantages in favor of the change. The new arrangement allowed two terms of equal length whereas the old plan required three terms of unequal length,-- the subjects for certain hours all receiving the same credit regardless of the number of weeks. The plan called for only two registration and final examination periods a year with corresponding reductions in clerical work in reporting and recording grades. The system also simplified the preparation of the classroom programs by permitting the use and dovetailing of three-and two-hour courses. Many other schools were adopting the plan or had already done so, thereby simplifying the transfer of credits between institutions.

The curricula as they appeared under the new calendar after the change at that time, are outlined on the following pages. Under these arrangements, practically all courses required for graduation were rigidly prescribed, as they had been under the three-term plan,-there having been no provision made for free electives of any kind except for a two-hour period in Electrical Engineering.

The curriculum in Mechanical Engineering as arranged when the Semester plan went into Effect in 1898-99.-

COURSE OF INSTRUCTION

Required for the Degree of B. S. in Mechanical Engineering

First Year

1. Advanced Algebra and Trigonometry (Math. 2,4); Elements of Drafting, Descriptive Geometry (Drawing, Gen. Eng'g 1a, 1b); French 5, or German B or 1 or 4, or English 1; Shop Practice (Mech. Eng'g 1); Military 1, 2; Physical Training 1,3.

2. Analytical Geometry (Math. 6); Descriptive Geometry, Lettering, Sketches (Drawing, Gen. Eng'g 2a, 2b, 2c); French 5, or German 2 or 6, or English 2; Shop Practice (Mech. Eng'g 1); Military 2; Physical Training 1,3.

Second Year

1. Differential Calculus (Math. 7); Physics 1,3; Rhetoric 2; Elements of Machine Design (Mech. Eng'g 4); Shop Practice (Mech. Eng'g 2); Military 2.

2. Integral Calculus (Math. 9); Physics 1, 3; Rhetoric 2; Elements of Machine Design (Mech. Eng'g 4); Shop Practice (Mech. Eng'g 2); Military 2.

Third Year

1. Analytical Mechanics and Resistance of Materials (Theo. and Appl'd. Mech. 1, 2a); Chemistry 1; Power Measurements (Mech. Eng'g 3); Mechanism (Mech. Eng'g 5); Steam Engines (Mech Eng'g 16).

2. Resistance of Materials, and Hydraulics (Theo. and Appl'd Mech. 2b,3); Chemistry 16; Power Measurements (Mech. Eng'g 3); Steam Boilers (Mech. Eng'g 17); Electrical Engineering (Elect. Eng'g 1); Surveying (Civil Eng'g 10).

Fourth Year

1. Thermodynamics (Mech. Eng'g 7); Heat Engines (Mech. Eng'g 6); High Speed Engines and Valve Gears (Mech. Eng'g 14); Advanced Designing (Mech. Eng'g 9); Advanced Mechanical Laboratory (Mech. Eng'g 12); Seminary Mech. Eng'g 10); Thesis.

2. Mechanics of Machinery (Mech. Eng'g 8); Graphical Statics of Mechanisms (Mech. Eng'g. 18); Estimates (Mech. Eng'g 10); Advanced Designing (Mech. Eng'g. 9); Advanced Mechanical Laboratory (Mech. Eng'g 12); Seminary (Mech. Eng'g 19); Thesis.

Railway Option in Mechanical Engineering.- As stated in the 1898-99 Catalogue:

"The railroad interests of the State of Illinois, as well as of the United States, have become so important as to demand a separate recognition in the courses of those educational institutions which offer instruction in engineering."

"Wishing to meet the demand for specialties along this important line, the University has established an undergraduate course leading to the degree of B. S. in Railway Engineering, and also provides for graduate instruction and investigation in this department leading to a second degree."

"Three leading railroads of the State have promised their cooperation in the work of the department. The department of civil engineering already furnishes special instruction relating to construction and maintenance of way. In this new course the purpose is to pay more attention to the problems of motive power and machinery, including construction, design and operation of locomotives and rolling stock, as well as tests of fuel, water supply, materials, and supplies."

"The completion of the new railway shops of the P. & E. Division of the C., C., C. & St. L. Ry. at Urbana, furnishes exceptional opportunity for inspection of construction and repair work, and the assured aid which this department will receive from the management of these shops cannot but be of considerable value to the student."

COURSE OF INSTRUCTION

Required for the Degree of B. S. in Railway Engineering

First, second, and third years same as the curriculum in Mechanical Engineering.

Fourth Year

1. Thermodynamics (Mech. Eng'g 7); Locomotive Engines (Ry. Eng'g 1); Locomotive Engine Design (Ry. Eng'g 2); Shop Systems (Ry. Eng'g 3); Locomotive Road Tests (Ry. Eng'g 4); Seminary (Mech. Eng'g 19); Thesis.

2. Mechanics of Machinery (Mech. Eng'g 8); Compressed Air in Railway Service (Ry. Eng'g 5); Railway Estimates (Ry. Eng'g 6); Advanced Designing (Ry. Eng'g 7); Dynamometer Car Tests (Ry, Eng'g 8); Seminary (Mech. Eng'g 19); Thesis.

This is the first instance of curricular specialization within the College of Engineering, although it differed from the regular curriculum in Mechanical Engineering only in the senior year. The railroads were at about their peak of development at that time and offered attractive opportunities in the design, construction, operation, and maintenance of motive power and rolling stock.

Railway Lines in Industrial Engineering.— As stated in the 1952-53 Catalogue:

"The railroad interests of the State of Illinois, as well as of the United States, have become so important as to furnish a separate specialty in the training of young mechanical engineers; [illegible] instruction in engineering."

"Owing to [illegible] the University [illegible] in Railway Engineering, [illegible] instruction and investigation in this important [illegible] to a normal degree."

"[illegible] railroads of the State have provided their cooperation in the work of the Department. [illegible] special instruction relating to [illegible] and maintenance of ways. [illegible] the problems of railway power and machinery, locomotive construction, design and operation of locomotives and rolling stock, as well as [illegible] and equipment."

"The [illegible] of the C. [illegible] opportunity for the inspection of locomotives, [illegible] will receive from the [illegible] will be of considerable value to its students."

COURSE OF INSTRUCTION

Required for the Degree of B. S. in Railway Engineering

First, second, and third years same as for curriculum in Mechanical Engineering.

Fourth Year

1. [illegible]

2. [illegible]

This is the first [illegible] of [illegible] Engineering, [illegible] in Railway Engineering [illegible]

The Curriculum in Civil Engineering when first placed on the Semester Plan in 1898-99.

COURSE OF INSTRUCTION

Required for the Degree of B. S. in Civil Engineering

First Year

1. Advanced Algebra and Trigonometry (Math. 1, 3); Elements of Drafting, Descriptive Geometry (Drawing, Gen. Eng'g 1a, 1b); Shop Practice (Mech. Eng'g 1); French 5, or German B or 1 or 4, or English 1; Military 1, 2; Physical Training 1,3.

2. Analytical Geometry (Math. 6); Descriptive Geometry, Lettering, Sketching (Drawing, Gen. Eng'g 2a, 2b, 2c); Shop Practice (Mech. Eng'g 1); French 5, or German 2 or 6, or English 2; Military 2; Physical Training 1, 3.

Second Year

1. Differential Calculus (Math 7); Land Surveying or Topographical Drawing (Civil Eng'g 1, 2); Physics 1,3; Rhetoric 2; Military 2.

2. Integral Calculus (Math. 9); Topographical Surveying, and Transit Surveying and Leveling (Civil Eng'g 2,3); Physics 1,3; Rhetoric 2; Military 2.

Third Year

1. Analytical Mechanics, and Resistance of Materials (Theo. & App. Mech. 1,2); Railroad Engineering (Civil Eng'g 4); Chemistry 1; Steam Engines (Mech. Eng'g 16).

2. Resistance of Materials, Hydraulics (Theo. & App. Mech. 2,3); Graphical Statics and Roofs (Arch.5); Road Engineering (Mun. & San. Eng.1); Descriptive Astronomy (Astron. 4); Steam Boilers (Mech. Eng'g 17).

Fourth Year

1. Bridge analysis, and Bridge Details (Civil Eng'g 12,13); Masonry Construction (Civil Eng'g 5); Water Supply Engineering (Mun. & San. Eng'g 2); Practical Astronomy (Astron. 6); Thesis.

2. Bridge Details, and Bridge Design (Civil Eng'g 13, 14); Sewerage (Mun. & San. Eng'g 3); Railroad Structures (Civil Eng'g 17); Tunneling (Civil Eng'g 15), or Geodesy (Civil Eng'g 6); Economics 2 or 8; Engineering Contracts and Specifications (Civil Eng'g 16); Thesis.

[illegible]

[illegible]

[illegible]

[illegible]

1. [illegible]

2. [illegible]

[illegible]

1. [illegible]

2. [illegible]

[illegible]

1. [illegible]

2. [illegible]

[illegible]

1. [illegible]

2. [illegible]

The Curricula in Architecture when first placed on the Semester Plan in 1898-99.-

ARCHITECTURE

Required for Degree of B. S. in Architecture

First Year

1. Advanced Algebra and Trigonometry (Math 2, 4); Elements of Drafting, Descriptive Geometry (Drawing, Gen. Eng'g 1); Free-hand Drawing or Modeling (Arch.20 or 21); French 5, or German B or 1 or 4, or English 1; Military 1, 2; Physical Training, 1, 3 or 7, 9.

2. Analytical Geometry (Math. 6); Descriptive Geometry, Lettering, Sketching (Drawing, Gen. Eng'g 2); Free-hand Drawing (Arch. 20 Or 21); French 5, or German 2 or 6, or English 2; Military 2; Physical Training, 1, 3.

Second Year

1. Applied Mechanics (Theo. and App. Mech. 4); Wood Construction (Arch. 2); The Orders of Architecture (Arch. 8); Physics 1, 3; Monthly Problems (Arch. 9); Rhetoric 2; Military 2.

2. Strength of Materials (Theo. and App. Mech. 5); Masonry and Metal Construction (Arch.3); Requirements and Planning of Buildings (Arch. 15); Physics 1, 3; Monthly Problems (Arch. 9); Rhetoric 2; Military 2.

Third Year

1. History of Architecture (Arch. 6); Details of Styles (Arch.7); Architectural Seminary (Arch. 11); Sanitary Construction (Arch. 4); Architectural Design (Arch. 17); Chemistry1or Economics 1a;;Monthly Problems (Arch. 9).

2. History of Architecture (Arch. 6); Details of Styles (Arch. 7); Architectural Seminary (Arch. 14); Graphic Statics and Roofs (Arch. 5); Architectural Perspective (Arch. 14); Architectural Composition (Arch. 18); Monthly Problems (Arch. 9).

Fourth Year

1. Superintendence (Arch. 12a); Estimates (Arch. 12b); Specifications (Arch. 12c); Heating and Ventilation (Arch. 13); Renaissance Design (Arch. 22); Gothic Design (Arch. 23); Romanesque Design (Arch 24);

2. Working Drawings (Arch. 10); Residence Design (Arch. 16); Design of Ornament (Arch. 25); Surveying (Civil Eng'g 10); Thesis.

ARCHITECTURAL ENGINEERING

Required for the Degree of B. S. in Architectural Engineering

First Year

The first year is the same as Architecture except that Shop practice (Mech. Eng.1) was made optional with Free-hand Drawing or Modeling in both semesters.

Second Year

1. Differential Calculus (Math. 7); Wood Construction (Arch. 2); The Orders of Architecture (Arch. 8); Physics 1, 3; Rhetoric 2; Military 2.

2. Integral Calculus (Math. 9); Masonry and Metal Construction (Arch.3); Requirements and Plans of Buildings (Arch. 15); Physics 1, 3; Rhetoric 2; Military 2.

Third Year

1. Analytical Mechanics and Resistance of Materials (Theo. and App. Mech. 1, 2a); History of Architecture (Arch.6); Architectural Seminary (Arch. 11); Sanitary Construction (Arch. 4); Chemistry 1.

2. Resistance of Materials, Hydraulics (Theo. and App. Mech. 2b, 3); History of Architecture (Arch. 6); Architectural Seminary (Arch. 11); Graphic Statics and Roofs (Arch. 5); Chemistry 16); Electrical Eng'g (Elect. Eng'g. 1).

Fourth Year

1. Superintendence (Arch. 12a); Estimates (Arch. 12b); Specifications (Arch. 12c); Heating and Ventilation (Arch.13); Architectural Engineering (Arch. 19); Bridge Analysis and Details (Civ. Eng'g 12, 13).

2. Working Drawing (Arch. 10); Residence Design (Arch 16); Bridge Details and Design (Civ. Eng'g 13, 14); Surveying (Civ. Eng'g 10); Thesis.

The Curriculum in Electrical Engineering as Arranged when the Semester Plan went into effect in 1898-99.- As stated in the 1898-99 Catalogue: "This is a course in theoretical and applied electricity. It extends through four years. The first two years are substantially the same as in the other engineering courses. In the last two years, the course includes the fundamental subjects in theoretical and applied mechanics and steam engineering; but a large part of the time is given to courses in electricity and its applications. The features of the instruction are the facilities offered for laboratory work by the student; the work done in calculating, designing, and making working drawings of electrical apparatus; and the senior thesis requirements and facilities offered for original work."

[illegible]

[illegible]

[illegible]

The first goal is the [illegible]

[illegible]

[illegible]

1. [illegible]

2. [illegible]

[illegible]

1. [illegible]

2. [illegible]

[illegible]

1. [illegible]

2. [illegible]

[illegible]

COURSE OF INSTRUCTION

Required for the Degree of B.S. in Electrical Engineering

First and Second Years are the same as the curriculum in Mechanical Engineering

Third Year

1. Analytical Mechanics and Resistance of Materials (Theo. and Appl'd Mech. 1,2a); Mechanism (Mech. Eng'g 5); Chemistry 1; Electrical and Magnetic Measurements (Phys. 4); Steam Engines (Mech. Eng'g 16).

2. Resistance of Materials, Hydraulics (Theo. and Appl'd Mech. 2b, 3); Mechanical Engineering Laboratory (Mech. Eng'g 13); Steam Boilers (Mech. Eng'g 17); Elements of Dynamo Machinery (Elect. Eng. 11); Electrical and Magnetic Measurements (Phys. 4); Elective; Math. 16, or Chemistry 3b, or Civil Engineering 10 (three semester-hours)

Fourth Year

1. Thermodynamics (Mech. Eng'g 7); Dynamo-Electric Machinery(Elect. Eng. 2); Electrical Engineering Laboratory (Elect. Eng'g 3); Electrical Design(Elect. Eng'g. 4); Photometry (Elect. Eng'g 5); Telegraphy and Telephony (Elect. Eng'g 6); Electric Wiring and Distribution (Elect. Eng'g 8); Seminary (Elect. Eng'g 10); Thesis; Elective (two semester-hours); Electrical Engineering 7.

2. Alternating Currents and Machinery (Elect. Eng'g 12); Alternating-Current Laboratory (Elect. Eng'g 13); Electrical Design (Elect. Eng'g 14); Transmission of Power (Elect. Eng'g 15); Electric Lighting, Central Station (Elect. Eng'g 9); Seminary (Elect. Eng'g 10); Advanced Electrical Measurements (Phys. 9); Thesis.

The Curriculum in Municipal and Sanitary Engineering after the Semester Plan went into effect in 1898-99.-

COURSE OF INSTRUCTION

Required for the Degree of B. S. in Municipal and Sanitary Engineering

First and second years same as Civil Engineering

Third Year

1. Analytical Mechanics, Resistance of Materials (Theo. and Appl'd Mech. 1, 2a); Physics Bacteriology (Mun. and San. Eng. 5a); Chemistry 1a; Railroad Engineering (Civil Eng'g 4a); Steam Engines (Mech. Eng'g 16).

2. Resistance of Materials, Hydraulics (Theo. and Appl'd Mech. 2b, 3); Road Engineering (Mun. and San. Eng 1); Graphic Statics and Roofs (Arch. 5); Chemistry 3a; Steam Boilers (Mech. Eng'g 17); Electrical Engineering).

Fourth Year

1. Bridges (Civil Eng'g 12,13); Chemistry 20; Masonry Construction (Civil Eng'g 5); Water Supply Engineering (Mun. and San. Eng'g 2) Thesis.

2. Bridge Design (Civil Eng'g 13, 14a); Engineering contracts and Specifications (Civil Eng'g 16); Mechanical Engineering Laboratory (Mech. Eng'g 13); Sewerage (Mun. and San. Eng'g 3); Water Purification, Sewage Disposal, and General Sanitation (Mun. and San. Eng'g 6); Thesis.

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[illegible]

1. [illegible]

2. [illegible]

[illegible]

1. [illegible]

2. [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

1. [illegible]

2. [illegible]

[illegible]

1. [illegible]

2. [illegible]

B. COURSES AND CURRICULA FROM 1900 to 1922

a. COURSES AND CURRICULA FROM 1900 to 1910

<u>The First Curricula in Ceramics and Ceramic Engineering.-</u> The Register of 1905-06 contained the following announcement of courses of study in Ceramics and Ceramic Engineering, the first of their kind here, listed in the College of Science, for the work had not yet been transferred to the College of Engineering:

PROSPECTUS OF COURSE IN CERAMICS

First Year

First Semester		Second Semester	
subject	S.H.	subject	S.H.
General Chemistry	5	Qualitative Analysis (Chem. 3a)	5
Alg. and Trig. (Math 2, 4)	5	Analytical Geometry (Math. 6)	5
Rhetoric 1	3	Rhetoric	3
Classification and Physical Testing of Clays (Cer. 1)	3	Winning and Preparation of Clays (Cer. 2)	3
Military (Mil. 2)	1	Physical Training	1
Physical Training	1	Military (Mil. 1, 2)	2
Total	18	Total	19

Second Year

Qualitative Analysis (Chem. 5a)	5	Silicate Analysis (Chem 5a)	5
Physics 1, 3	5	Physics 1, 3	4
Mineralogy (Geol. 5) 1, 2	5	Geology 1	5
Military	1	Physical Calculations (Cer.3)	2
Total	16	Military	1
		Total	17

Third Year

German, or French 2	4	German, or French 2	4
Physics of Heat (Phys. 16a, 16b)	4	Clay Modeling (A and D 8)	2
General Engineering Drawing	3	Working Drawings (Arch. 10)	1
Free Hand Drawing (A and D 1)	2	Body Making (Cer. 5)	6
Drying and Burning (Cer.4)	4	Economic Geology of Ceramic Materials (Geol. 2)	2
Total	17	Total	15

Fourth Year

Calculus (Math. 8a)	5	Physical Chemistry (Chem. 31, 33)	5
Glazes (Cer. 6)	6	Colors of Bodies and Glazes (Cer. 8)	3
Ceramic Stoichiometry (Cer. 7)	2	Thesis (Cer. 1)	8
Analysis of Glasses and Glazes (Chem. 6. 8a)	3	Total	16
Total	16		

COURSE IN CERAMIC ENGINEERING

First Year

FIRST SEMESTER Subject	S.H.	SECOND SEMESTER Subject	S.H.
General Chemistry (Chem. 4)	5	Qualitative Analysis (Chem. 3a)	5
Alg. and Trig. (Math. 2,4)	5	German 5	4
German 4	4	Analytical Geometry (Math. 6)	5
General Engineering Drawing	3	Military	2
Military	1	Physical Training	1
Physical Training	1	Total	17
Total	19		

Second Year

Qualitative Analysis (Chem. 5a)	4	Silicate Analysis (Chem. 5b)	6
Physics 1, 3	5	Physics 1, 3	4
Geology 5	4	Geology 1	5
Calculus (Math. 5)	5	Winning and Preparation of Clays (Cer. 2)	3
Military	1	Military	1
Total	19		19

Third Year

Physics (16a, 16b)	4	Analytical Mechanics (T. & A.M.7)	3
Drying and Burning (Cer. 4)	4	Body Making (Cer. 5)	6
Electrical Engineering (E. E. 2)	2	Working Drawings (Arch. 10)	1
Electrical Engineering Laboratory (E. E. 26)	2	Steam Engines and Boilers (M.E. 1)	3
Rhetoric 1	3	Rhetoric 1	3
Total	15	Total	16

Fourth Year

Analytical Mechanics (T. & A.M. 8)	2 1/2	Surveying (C.E. 10)	2
Resistance of Materials (T. & A.M. 9)	3 1/2	Geology 2	2
Ceramic Stoichiometry (Cer. 7)	2	Ceramic Construction (Cer. 10)	3
Glazes (Cer. 6)	6	Thesis (Cer. 1)	8
Thesis (Cer. 1)	1		
Total	15		15

The ceramic industry was relatively new and undeveloped in Illinois at that time; and it was the purpose of these curricula to educate men for positions of responsibility and leadership in the development of the clay resources and other ceramic interests of the State,- for men who could build up a body of knowledge upon which to found the industry, and for men who were sufficiently skilled to advance the industry to the status of a profession. The course of study in Ceramics was rather highly specialized, containing no subjects in mechanics and not

many others of a technical nature outside of its own particular area. It was designed to prepare men especially for chemical or other technological work in the laboratories of ceramic industries. The course of study in ceramic engineering contained the same basic engineering subjects as other engineering curricula and was designed to train men to build and operate ceramic plants.

Curricula in Railway Engineering in 1907-08.---The 1907-08 issue of the Register contained the following arrangement of courses in Railway Engineering,- the first schedule of courses in this newly-created department:

COURSE OF STUDY
REQUIRED FOR THE DEGREE OF B.S. IN RAILWAY CIVIL ENGINEERING [1]

FIRST YEAR

FIRST SEMESTER Subject	S.H.	SECOND SEMESTER Subject	S.H.
General Engineering Drawing (G.E.D. 1)	4	Descriptive Geometry (G.E.D. 2)	4
Trigonometry (Math. 4)	2	Analytical Geometry (Math. 6)	5
Advanced Algebra (Math. 2)	3	French 1, or German 3 or 5 or 6, or English 27, or Rhetoric 11, or Spanish 1,	4
French 1, or German 1 or 4, or English 1, or Spanish 1,	4	Shop Practice (M.E.1)	3
Shop Practice (M.E.1)	3	Military Drill (Mil.2)	1
Military Drill (Mil.2)	1	Drill Regulation (Mil. 1)	1
Gymnasium (Phys.Tr. 1,3)	1	Gymnasium (Phys. Tr. 1, 3)	1
Total	18	Total	19

SECOND YEAR

Surveying (C.E. 21)	5	Topographic Surveying (C.E. 22)	4
Differential Calculus (Math. 7)	5	Railroad Curves (C. E. 23)	1
Physics Lectures (Phys. 1)	3	Integral Calculus (Math. 9)	3
Physics Laboratory (Phys. 3)	2	Physics Lectures (Phys. 1)	2
Rhetoric 1	3	Physics Laboratory (Phys. 3)	2
Military Drill (Mil. 2)	1	Rhetoric 1	3
		Analytical Mechanics (T. & A.M. 7)	3
		Military Drill (Mil. 2)	1
	19	Total	19

1. For lack of instructor, the curriculum did not go into effect until 1908-09.

THIRD YEAR

Railroad Location, Construction and Maintenance (C.E. 4)	5	Railway Yards and Terminals (Ry.E.31)	1
Analytical Mechanics (T. & A.M. 8)	2½	Railway Structures (Ry.E. 32)	1
Resistance of Materials (T. & A. M. 9)	3½	Graphic Statics (C.E. 20)	2
Engineering Materials (T. & A.M. 6)	1	Hydraulics (T. & A.M. 10)	3
Chemistry 1	4	Steam Engines and Boilers (M.E. 11)	3
		Astronomy 3 and 6 or Geol. 13	5
		Principles of Economics (Econ. 2)	2
Total	16	Total	17

FOURTH YEAR

Economic Theory of Ry. Loc. (Ry. E. 33)	4	Railway Operation (Ry. E. 34)	4
Railway Management (Econ. 13)	3	Signal Engineering (Ry. E. 35)	1
Masonry Construction (C.E. 5)	5	Seminary (Ry. E. 50)	1
Bridge Design (C.E. 12)	2	Railway Systems (Econ. 14)	3
Metal Structures (C.E. 24)	1	Bridge Design (C.E. 14a)	3
Tunneling (C.E. 18)	1	Engineering Contracts and Spec.(C.E.16)	2
Thesis (Ry. E. 60)	1	Thesis (Ry. E. 60)	2
Total	17	Total	16

The curriculum was identical with that in Civil Engineering during the first five semesters and differed from it during the last three semesters only that a few special courses dealing with the location, design, construction, and maintenance of track and equipment, and the design of railway structures, were introduced to prepare for positions those who planned to enter the engineering departments of steam-railway lines.

COURSE OF STUDY

REQUIRED FOR THE DEGREE OF B. S. IN RAILWAY ELECTRICAL ENGINEERING

FIRST YEAR

FIRST SEMESTER	SECOND SEMESTER
Subject	Subject

Same as
Railway Civil Engineering

SECOND YEAR

Machine Shop (M.E. 2)	2½	Machine Shop (M.E. 2)	2½
Machine Design (M.E. 4)	2½	Mechanism (M. E. 5)	2½
Differential Calculus (Math. 7)	5	Integral Calculus (Math. 9)	3
Physics Lecture (Phys. 1)	3	Physics Lecture (Phys. 1)	2
Physics Laboratory (Phys. 3)	2	Physics Laboratory (Phys. 3)	2
Rhetoric 1	3	Rhetoric 1	3
Military Drill (Mil. 2)	1	Analytical Mechanics (T. & A.M. 7)	3
		Military Drill (Mil. 2)	1
Total	19	Total	19

THIRD YEAR

Dynamo-Electric Machinery (E.E. 16)	4	Alternating Currents (E.E. 5)	4
Electric and Magnetic Meas.(Phys.4)	2	E. E. Laboratory (E.E. 22)	2
An. Mechanics (T. & A.M. 8)	2½	Electric and Magnetic Meas.(Phys.4)	2
Resistance of Materials (T. & A.M.9)	3½	Hydraulics (T. & A.M. 10)	3
Engineering Materials (T. & A.M. 6)	1	Surveying (C.E. 10)	2
Chemistry 1	4	Steam Engineering (M.E. 23)	3
Total	17	Total	16

FOURTH YEAR

Ry. Lab. and Road Tests (Ry.E. 62)	2	Traction (Ry. E. 61)	2
Loco. Road Tests (Ry. E. 4)	3	Ry. Lab. and Road Tests (Ry.E.63)	2
Seminary (Ry. E. 10)	1	Dynamometer Car Tests (Ry. E. 8)	1
Adv. Alternating Currents (E.E.14)	3	Seminary (Ry. E. 10)	1
Electrical Distribution (E.E. 15)	3	Power Plants (E.E. 11)	1
Thermodynamics (ME. 15)	3	Economics 16	2
Economics 2	2	Thesis (Ry. E. 30)	3
Total	17	Total	15

The arrangment of the program was much like that in electrical engineering and specialization did not begin until the senior year. The special courses in railway electrical engineering were concerned with the design and construction of electric railway equipment, the operation and performance of electric cars and locomotives, and the problems that arose in the electrification of steam lines, and were intended for students that planned to serve on electric railways or in the electrical departments of steam roads.

COURSE OF STUDY

REQUIRED FOR THE DEGREE OF B. S. IN RAILWAY MECHANICAL ENGINEERING

The first and second years are the same as the curriculum
in Railway Electrical Engineering

THIRD YEAR

SEMESTER Subject	S.H.	SEMESTER Subject	S.H.
Steam Engineering (M.E. 23)	3	Thermodynamics (ME. 7)	3
Graphic Stat. of Mech. (ME. 18)	2	Power Meas. (M. E. 3)	3
Seminary (M. E. 29)	1	Engineering Chemistry (Chem. 16) or	
Analytical Mechanics (T. & A.M. 8)	2½	Graphic Kinetics (M. E. 25)	3
Resistance of Materials(T. & A.M. 9)	3½	Seminary (M. E. 29)	1
Engineering Materials (T. & A.M. 6)	1	Hydraulics (T. & A.M. 10)	3
Chemistry 13 or E. E. 16	4	Surveying (C. E. 10)	2
		Electrical Eng.(E.E. 25 or E.E.1)	2
Total	17	Total	17

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]
Total	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]
Total	[illegible]	Total	[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible] [illegible]

[illegible] [illegible]

[illegible]	[illegible]	[illegible]	[illegible]
Total	[illegible]	Total	[illegible]

FOURTH YEAR

Locomotive Engines (Ry. E. 1)	2	Shop and Auxiliary Equipment(Ry.E.5)	1
Locomotive Design (Ry. E. 2)	3	Advanced Design (Ry. E. 7)	3
Locomotive Road Tests (Ry. E. 4)	3	Traction (Ry. E. 61)	2
Shop Systems (Ry. E. 3)	1	Dynam. Car Tests (Ry. E. 8)	1
Seminary (Ry. E. 10)	1	Seminary (Ry. E. 10)	1
Mech. of Machinery (M..E. 8)	2	Mech. of Mach. (M..E. 8)	3
Elect. Eng. (E.E. 6 or E.E. 21)	2	Economics 16	2
Economics 2	2	Thesis (Ry. E. 30)	3
Total	16	Total	16

This course of study was patterned closely after mechanical engineering and differed from it only in the senior year. The special courses dealt with the design of locomotives and cars, the resistance of steam trains, the performance and tests of locomotives, and tests of railway equipment, and were intended for those who planned to enter the motive-power department of steam transportation lines or engage in the production of railway rolling stock.

The First Curriculum in Mining Engineering after the Department was Re-established in 1909.-The first course of study in Mining Engineering after the Department was re-established in 1909 appeared as follows:

Course of Study

Required for the Degree of B. S. in Mining Engineering

FIRST YEAR

First Semester		Second Semster	
General Engineering Drawing (G.E.D.1)	4	Descriptive Geometry (G.E.D. 2)	4
Trigonometry (Math. 4)	2	Analytical Geometry (Math. 6)	5
Advanced Algebra (Math. 2)	3	French 1 or German 3 or 5 or 6, or English 2, or Rhetoric 11, or Spanish 1	4
French 1 or German 1 or 4 or English 1 or Spanish 1	4	Shop Practice (M. E. 1)	3
Shop Practice (M.E. 1)	3	Military Drill (Mil. 2)	1
Military Drill (Mil. 2)	1	Drill Regulations (Mil. 1)	1
Gymnasium (Phys. Tr. 1)	1	Gymnasium (Phys. Tr. 1)	1
Total	18	Total	19

SECOND YEAR

Differential and Integral Calculus (Math 5a)	5	Physics Lectures (Phys. 1)	2
Physics Lecture (Phys. 1)	3	Physics Laboratory (Phys. 3)	2
Physics Laboratory (Phys. 3)	2	Rhetoric (1)	3
Military Drill (Mil. 2)	1	Military Drill (Mil. 2)	1
Rhetoric (1)	3	Analytical Mechanics (T. & A.M. 7)	3
Elementary Chemistry (1a or 1b)	4	Chemistry (2 & 3)	5
Mining Principles (Min. 1)	1	Earth & Rock Excavation (Min. 2)	3
Total	19	Total	19

THIRD YEAR

Analytical Mechanics (T. & A.M. 8)	2½	Graphic Statics (C. E. 20)	2
Resistance of Materials (T. & A.M.9)	3½	Topographics Surveying (C.E. 22)	2
Chemistry (5a)	5	Mine Surveying (Min. 4)	2
Surveying (C.E. 21)	5	Steam Engineering (M. E. 23)	3
Mining Methods (Min. 3)	2	Engineering Geology (Geol. 13)	5
		Mine Ventilation (Min. 5)	3
Total	18	Total	17

FOURTH YEAR

Technical Gas & Fuel Analysis, Calorimetry (Chem 65)	2	Design (C. E. 14b)	2
Special Geology of Coal	3	Dynamo Electric Machinery (E.E. 16)	4
Bridge Analysis (C.E. 12)	2	Mine Administration & Organization (Min. 7)	1
Investigation of Structures (C.E.13a)	2	Thesis (Min. 11)	3
Mine Machinery (M. E. 35)	2	Mining Law (Min. 8)	1
Mechanical Engineering of Colliers (Min. 6)	5	Mining Laboratory (Min. 10)	2
		Engineering Contracts & Specifications (C.E. 16)	2
		Economics of Coal (Min. 9)	1
Total	16	Total	16

The Department of Mining Engineering was re-established by urgent request of the best mining interests of the State to provide training for men in the fundamentals of mining engineering so as to maintain the industry on the level of a learned profession. Specialization did not begin until the sophomore year and then only to a very limited extent. Throughout the entire program, the schedule contained a liberal number of subjects in allied departments, but these were all essential to a well-balanced curriculum in this particular field. As coal was the dominating mining interest in the State, it received more attention than is sometimes allotted to it in other sections, - an arrangement, however, that was economically justifiable from the University's viewpoint.

b. SUMMER READING

General. - In a desire to promote a more general education of the engineering students and particularly to cultivate a familiarity with, and an appreciation of, good literature, the faculty of the College of Engineering in the spring of 1907 made a requirement that all undergraduate students should do a certain amount of prescribed non-professional reading, nominally in the summer vacation following the freshman year and also in that following the sophomore year. A little pamphlet was published

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giving a list of four to six books each in history, fiction, poetry, and science for freshmen, and a similar one for sophomores. To each volume was assigned a certain number of points, and the student was to read enough books to aggregate 100 points for each summer vacation. The students were expected to read approximately half the books in each list. Each student was given a printed sheet to facilitate the reporting of his reading. The prescribed books were carefully selected for their value from the point of view of general training; but an attempt was made to include only readable and attractive volumes. The pamphlet also contained a comprehensive list of supplemental reading in fiction, history, biography of statesmen and of scientific men, politics, science, engineering, and art and artists, for the use of any who might desire to extend his reading beyond the prescribed lists.

The results of the experiment were a disappointment. First, not very many of the students did the reading in vacation. Some who worked during the vacation said they were too tired after a day's work, or lacked reasonable facilities for doing the reading. Others claimed that it was difficult or impossible to get the books, although all of them were standard and probably could be obtained in any public library; however, the pamphlet referred to above gave the publisher and price of cheap editions of each book, and the total cost of either list was not so great but that most of the men could have bought the books if they had been inclined to do so. Some students deliberately postponed the reading until they returned to the University the succeeding fall. The result was that most of the reading was done during the early part of the succeeding semester; and thus what was intended for pleasant and profitable summer reading became in the main an addition to a curriculum already reasonably full.

Second, not many students appreciated the object sought; and the doing of the work mainly during the semester had a tendency to do it hastily and superficially, and without much benefit. Curiously, many of the more ambitious students objected most stronuously to giving time to this reading on the ground that such work had no value for an engineer; and often those who needed such work most were the most urgent in presenting this view. Not infrequently such students postponed the summer

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reading to the eleventh hour; and when informed that they could not be graduated without a credit for summer reading, brought in a report in an astonishing brief time.

In an attempt to increase the interest in such reading, the requirement was reduced in 1912 to one half, but without any beneficial result. Then, all requirements concerning summer reading were abandoned in 1918.

Later, two other attempts were made to secure the same object as that aimed at in requiring summer reading; viz., the liberalizing of the engineering curricula, and the passage of a rule concerning a student's deficiency in the use of English. Both of these plans will be discussed later in the chapt

c. FACULTY STUDIES OF ENGINEERING CURRICULA, 1910-15

General. - In any growing institution, the curricula of the various departments are examined critically and modifications made from time to time as conditions justify, and even new curricula are occasionally added in an attempt to keep pace with the development of the specialization in subjects or as the finances and facilities of the institution permit, and old curricula are sometimes deleted. Thus, the existing curricula at any particular time are the results of developments by addition and substitution or even of elimination. Through such changes, the several existing curricula in an institution, particularly in the larger ones, are likely to differ from time to time somewhat in total amount of work and also in the relative quantity required in different classes of subjects. For example, when a new man comes to take charge of a particular line of work, he may desire to modify the curriculum in accordance with his particular views or his particular ability, in accordance with the most recent developments of a subject, or the demands of industry. Thus, due to changes in personnel and often to numerous other reasons, the curricula are constantly undergoing at least minor changes, although the possibility of making changes in a single curriculum is usually seriously limited by the requirements or contents of other curricula. Therefore, since it is desirable that the amount of work required of different students should be at least approximately the same throughout the institution, and since it is also desirable that the curriculum in any particular field

should in scope and character of work represent the best attainable, it is necessary to make a comprehensive study from time to time of the several curricula arrangements.

Such a study of the several curricula of the College of Engineering was suggested by Dean Goss on March 13, 1911; and for more than a year a large committee of the engineering faculty, under the chairmanship of Professor G. A. Goodenough, was industriously engaged in this investigation. From time to time, this committee made numerous and elaborate reports to the faculty which were often the occasion of long continued discussion. The following are the leading subjects considered and the conclusions reached.

1. Semester Hours Required for Graduation. Since the other undergraduate colleges of the University required 123 semester hours for graduation, exclusive of 7 in military and physical training, an inquiry was made as to whether or not the College of Engineering should continue to require 135, exclusive of 7 in military and physical training. Table XXII shows the number of semester hours required for graduation in engineering then in twelve of the leading institutions of this country. At that time the College of Engineering offered ten curricula, but only five were included in the table. The curricula in architecture and architectural engineering were not included, since these had recently been reorganized in accordance with the recommendations of the Collegiate Association of Architectural Schools, as mentioned later in this chapter. The curricula in railway civil, railway electrical, and railway mechanical engineering were omitted, since such courses were found only in the University of Illinois.

In Tables XXII and XXIII, C. E. stands for civil engineering, E. E. for electrical engineering, M. E. for mechanical engineering, Min. E. for mining engineering, and M. & S. E. for municipal and sanitary engineering.

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TABLE XXII - SEMESTER HOURS REQUIRED FOR GRADUATION IN ENGINEERING

UNIVERSITY	C. E.	E. E.	M. E.	MIN. E.	M. & S. E.
Columbia	180	170	187	183	180
Cornell	140		140		
Illinois	135	134	135	136	135
Lehigh	148	145	151	157	
Mass. Inst. Tech.					173.7
Michigan	140	140	140	140	140
Minnesota	152	159	158		141
Pennsylvania	168.5	171.5	183.1		157.2
Purdue	150.8	153.2	141.6		
Stevens			160		
Wisconsin	159	160	155	160	
Worcester	144	144	144		

On the basis of the showing in Table XXII, it was decided that the College of Engineering should continue to require 135 semester hours, exclusive of the 7 in military and physical training.

2. PROPORTION of Time to Different Lines of Work. A study was made to determine the proportion of time given in each curriculum to different groups of subjects. The subjects offered by the College were divided into four groups as follows:

A. Language and general cultural subjects.

B. Mathematics, pure and applied, including all technical subjects strongly mathematical in nature.

C. Technical laboratory, drafting, surveying, etc., and all other subjects that do not require extensive preparation outside of class.

D. Technical courses largely informational in character and less closely related than others to the specialized purpose of the course.

In this study no account was taken of the time devoted to military, physical training and thesis. The results of this investigation are given in Table XXIII.

TABLE XXIII - PROPORTION OF TIME ALLOCATED TO THE DIFFERENT GROUPS OF SUBJECTS IN THE CURRICULA

CURRICULUM	PERCENTAGE OF TOTAL TIME DEVOTED TO			
	Group A	Group B	Group C	Group D
C. E.	16.7	41.7	31.0	10.6
E. E.	14.0	50.4	31.7	3.9
M. E.	17.4	47.0	31.0	4.6
Min. E.	14.4	47.0	27.3	11.3
M. & S. E.	12.0	44.0	35.0	9.0

A similar study was made of the curricula in the leading engineering colleges of the United States and Canada, to determine the total amount of time given to the different groups of studies, and also the amount of time given to each group during each of the four years. In this study, also, no account was taken of the time devoted to military, physical training, and thesis. From this investigation the following conclusions were drawn: "(1), The amount of time given to the different groups seems not to follow closely any general law, and there is wide variation between different institutions; (2), the time given to Group A usually decreases during the four years; (3), the time given to Group B is fairly uniform during the four years, and is usually a little less than half the total for each semester; (4), the percentages for Group C are very erratic; (5) the work in Group D is such a small part of the total that it need not receive separate attention, the time devoted to this group being distributed among the other groups; (6), the percentage of the total time recommended for the three groups was approximately as follows: Group A, 25%; Group B, 45%; and Group C, 30%." These percentages were adopted as the guide to be used in revising the several curricula.

d. CHANGES MADE IN THE CURRICULA FOLLOWING THE RECOMMENDATIONS OF THE COMMITTEE

Undergraduate Thesis. - The thesis requirement for graduation was rescinded during the year 1912-13, to become effective at the beginning of the school year 1913-14. The committee of the faculty appointed to study revision of courses with Professor Goodenough as chairman presented the following recommendation during the year 1911-12:[1]

1. The Technograph, No. 2, Vol. XXVII, March, 1913, pages 153-154.

"A thesis as a rigid requirement is to be discontinued. A regular student of high standing may, however, with the approval of the head of the department, have an option between a thesis and some specified engineering subject."

"In the discussion which preceded the action taken, the problem was presented from many different points of view. It seemed to be the opinion of the faculty that a thesis possessed high educational value for some students, while its value to others was problematical. To whatever extent the thesis encouraged originality and independence in work, its value was conceded, but the opinion of individuals differed as to the extent to which these advantages were secured.

"Professor Baker maintained the argument that the preparation of a thesis afforded training for a student that he could not get elsewhere in his curriculum. The following is an extract from a printed circular concerning the selection of the subject for, and the preparation of a thesis, which he handed to each student early in his senior year:

"'The thesis differs from other subjects in the course in that in the latter the student is expected simply to follow the directions of the instructor, - to study specified lessons and recite thereon, to solve the problems assigned, to read the articles recommended; - while the preparation of the thesis is intended to develop the student's ability to do independent work. There is comparatively little in the ordinary college work to stimulate the student's power of initiative, but in his thesis work he is required to take the lead in devising ways and means. The power of self-direction, the ability to invent methods of attack, the capacity to foresee the possible results of experiments, and the ability to interpret correctly the results of experiments is of vital importance in the future of any engineering student. With certain limits, the thesis is a test of the present attainments of the student and also a prophecy of his future success. The interest of the University in thesis work is shown by the fact that the student receives individual instruction and practically has the resources of the institution placed at his command.'"

Thus, in 1913, after 40 years of experience requiring the thesis as a subject for graduation, the requirement was abolished, resulting in practically discontinuing the undergraduate thesis, although later issues of The Register carried the statement: "A senior of high standing in any curriculum, with the approval of the department concerned, may substitute for one or more technical courses an investigation of a special subject and write a thesis on the results".

Other Changes. - On recommendation of the Committee, the Faculty adopted the following other changes in the curricula to become effective at the beginning of the academic year 1914-15:

1. Chemistry was transferred from the junior to the freshman year.
2. Rhetoric was transferred from the junior to the freshman year.
3. Modern language was changed from the freshman to the sophomore year, and the requirements in modern language were to be English, French, or German; but a foreign language could not be taken unless French, German, or Latin should be offered for admission. Spanish, previously allowed,

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was no longer to be accepted as fulfilling the modern-language requirement.

4. Shop practice was transferred from the freshman and sophomore years to the sophomore and junior years; and since the character of the shop practice had been radically changed, it was dropped from all curricula except those of Electrical Engineering, Mechanical Engineering, and Railway Electrical and Railway Mechanical Engineering.

5. Economics, previously required in certain curricula, was made elective.

6. The time recommended for subjects in Group C (30%) was reduced to give room for nine semester-hours of non-technical electives in the last three semesters,-non-technical electives being defined as subjects offered in the College of Liberal Arts and Sciences or in the College of Commerce, not open to freshmen, that are approved by the head of the engineering department in which the student is registered.

Concerning this last change, it is appropriate to state that the chief reason for making the revision of the curricula was a desire to substitute a number of electives, and thus allow the student to broaden his education by taking some of the so-called cultural subjects. This decision to include nine semester-hours in the last three semesters of all curricula was the most radical of all the changes, since for many years at least, all subjects of the several curricula had been fully prescribed. This change seemed also to be the most desirable, since the faculty was well aware that its graduates had only a meager knowledge of economics, history, sociology, literature, etc. Furthermore, it seemed to be the consensus of opinion of leading practicing engineers that for an engineer to attain the highest success, it is necessary for him to have a broader education than that given by most engineering colleges. The faculty did not expect that nine semester-hours would give a student even a fairly complete knowledge of the subjects elected; but it did hope that the elective subjects would enable the student to get a glimpse of a new field that would inspire him to continue his study in that direction after graduation.

However, the result of the change was a disappointment to many students and to at least some members of the faculty. First, many of the students soughtadvance courses in mathematics, physics, chemistry, etc., in preference to the so-called cultural subjects. Second, as was to be expected, some students failed to appreciate either the need or the purpose of the cultural electives; and consequently did

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not give reasonable time or attention to them. Third, it was often impossible for a student to find a reasonably satisfactory elective, since he must first register in the prescribed subjects, which limited the hours open for the electives; and sometimes before the engineering student could reach the registration officer, the limit of the size of the class had been reached. Fourth, the election was further restricted in some of the departments by a requirement that a student might take work in that subject only by beginning with the freshman course, while freshman work could not be counted as a non-technical elective for a junior or senior engineer. Fifth, in some departments the only subject open as an elective to engineering students was taught as a part of a highly specialized course; and therefore to a large degree failed to accomplish the main object sought by the engineering student--to give him a general survey of the subject. For one or the other of the above reasons, the object sought by the electives was far from satisfactory; but doubtless in time the matter will be worked out better than at present, when the students come to understand better the purpose of the electives, and when adjustments can be made between the several departments so that engineering students can secure more satisfactory subjects as elective.

Added Emphasis on Rhetoric for Engineering Students.--Another matter closely connected with the introduction of cultural subjects into the engineering curricula met with more immediate success. Shortly after the revised curricula became effective, the engineering faculty sought to emphasize the importance of rhetoric for engineering students by proposing the following regulation:

"1. Rhetoric 1 and 2, freshman rhetoric, shall hereafter be a prerequisite for junior standing in the College of Engineering; and no student in this College shall be permitted to register in more than eight hours of prescribed junior work without having passed, or being registered in, Rhetoric 1 or 2.

"2. Any student in the College of Engineering whose written work shows that he is unable to use good English, should be reported by his instructor to a standing committee of the College of Engineering appointed for this purpose, which committee shall have the authority to direct the student to take as a prerequisite for graduation such additional instruction in rhetoric as may be prescribed by the Department of English."

When these regulations were presented for the approval of the University Senate, they were finally made effective for the entire university; and the admini-

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stration of the regulations was placed in the hands of a University Committee on Student's Use of English, the Secretary of which was an instructor in English. Students who were deficient in the use of either oral or written English were reported to this committee by the instructor, usually with samples of the faulty written work. The Secretary of the Committee then asked other instructors for samples of the student's written English, and for the opinion of the instructors as to the ability of the student to use good oral English. Next the committee determined what the student should do. Sometimes the student was merely admonished; sometimes he was required to write one or more themes, which were corrected and the reasons for the corrections explained to him; and sometimes the student was required to take further rhetoric instruction in class for which he received no academic credit. The regulations were reasonably successful in calling the attention of students to the importance of the habitual use of good English, and made an appreciable improvement in the language of quizzes, examinations, and reports, even though only a comparatively few instructors reported students for defective English. The students who were reported were almost, if not quite, unanimously pleased with the help received. It is interesting to note that the number of students reported was nearly the same proportionally from the several colleges; but possibly this fact might not be specially significant, since the instructors in the different colleges might not have been equally active in reporting cases.

Additional Changes in Shop-Practice Instruction.- Since college shops were first established, many radical changes have taken place in the social relations and mechanical processes in industry, and in methods of operation and management. Crude and expensive processes in all branches of industrial activity have been subjected to rigorous scientific investigation, which showed the possibility of great improvement in processes and methods. The application of these conclusions in manufacturing required technically-trained men, and therefore it seemed wise for the University to train its students in making such investigations and in applying the results of practice. Besides, training in elementary shop practice and machine manipulation, which constituted the backbone of the original work in all college

shops, no longer carried with it the same relative educational value as formerly entitled it to a place in the curriculum. Consequently, in 1913-14, the University began to make radical changes in college-shop practice, becom ing pioneers among the engineering colleges of the country in introducing into its courses a scientific study of the efficiency of processes, methods, and tools in manufacture,-an innovation it has retained to date. Under this plan the college shop becomes in fact a shop laboratory. In later years, this change at the University of Illinois attracted the attention of many persons connected with the operation of college shops; and as a result, the Director sent out in response to requests, great quantities of literature describing the work as administered here.

The ideals which govern the operation of the shop laboratories here[1] provide for the substitution of mental for manual training; a study of the reasons for, and the tests of the mechanical processes rather than mere manipulation in these processes. Operation of a machine is considered as incidental and secondary to the larger problems of production. Skill in manipulation is neither sought nor required, but the utmost importance is attached to an analysis of the contributing elements entering into the routine of manipulation, for the purpose of evaluating the factors involved in the production of parts. From a series of relatively unimportant exercises in the manipulation of tools (more value to a trade apprentice than a prospective engineer), shop work under the current policy directs the student into a study of the operation: (1), to determine the present practice in regard to the operation; (2), to formulate the most efficient methods for performing the operation; and (3), to apply these methods in order to secure efficiency in production.

The first involves a thorough analysis of all elements entering into the methods of doing the work in the usual way, a process which brings to light inefficiencies existing in all unscientifically-planned operations. For example, the student in making a scientific study of the drilling of metals, uses a drilling

1. The Administration of College Shop Laboratories, by W.F.M. Goss, Proc.of Soc. for Promotion of Engineering Education,1912, p. 129-32, and Shop Instruction at Univ. of Ill., by B.W.Benedict, Eng. Education,-the monthly bulletin of the Society for the Promotion of Engineering Education,--Dec.. 1915, p. 234-57.

machine equipped with a dynamometer which records the pressure on the drill, and from which can be determined the power used by drills of various forms and made of different qualities of steel, in drilling different metals; and by personal investigation the student determines the amount of work drills and drilling machines ought to do in various metals. Without such an investigation the customary form and material of the drill, and the usual rate of drilling arelikely to be accepted as satisfactory without question, when in fact the efficiency of the operation may be very low. In other words, the new shop courses do not stop with mere instruction in manipulation, as traditional practice prescribes, but go into a searching investigation after facts for the purpose of scientifically perfecting the operation.

From the investigation of present methods, the student is led through the second important state of the course,--the use of the information and data previously secured as a basis on which to develop the most efficient methods of performing the operation. All of the resources of the student are here called into play, as the work is creative and not bound by traditions or precedent. Complete knowledge of all contributing processes must be secured, if the data are not at hand.

With the second step in this program completed, the third can be approached with the same certainty that attends all processes founded upon scientific research. Equipped with the knowledge of the methods to be used in performing the operation, the student then proceeds to apply these methods to secure in practice what has previously been determined as standard performance. Thus we have, first, the investigation; second, the planning; and third, the execution. This last step is concerned with the problems of labor, management, production, and all the factors entering into shop operation.

Safety in Shop Laboratories.--In any college shop there is liability of accident as the students are young, and are inexperienced in the handling of machinery; and with the change in method and purpose of the shop work, the Director saw that the introduction of manufacturing processes would increase the possibility of accidents. Therefore, he put safety appliances on all the machines, and in addition gave a

special course of instruction on the methods of preventing accidents, and organized among the students taking shop work a "Life and Limb Club" in which the membership was optional but in which the student's cooperation was hearty and actually unanimous. Before signing the membership roll each member took a formal oath (moral but not legal) administered by a member of the instructional staff; and afterward a membership card was issued to each member in order to impress upon him the fact that the Club was real and that membership carried with it responsibility. Each student wore upon his shop clothing a celluloid button carrying the legend: "I will BE CAREFUL always". During some period of his shop work each student served as Safety Assistant for eight laboratory hours. He studied the matter of safety from several angles; and submitted a written report to the instructor on the safety appliances and the hazards, with any suggestions he might have, as to improvements in the safety appliances or in the method of operation. The result was that there were no serious accidents, and the member of minor accidents was less than under the former system of shop practice. In the methods employed for preventing accidents in the shop, the University of Illinois led all other college shops, and the National Safety Council recommended all other shops to follow the example here set.

e. SPECIAL ENGINEERING COURSES

Engineering Inspection Trip.--Very early in the history of the University, engineering inspection trips were taken by students of individual classes under supervision of faculty members to nearby points of interest for observations bearing on topics of current assignments. Senior-class inspection trips were scheduled by individual departments indenendently very early in the 1900's. For example, for a number of years after 1900, the Department of Civil Engineering generally conducted a trip in the fall to Danville and one in the spring to Chicago. During those same years, the Departments of Mechanical and Electrical Engineering made annual trips, usually to Chicago and Milwaukee. At first, such trips were quite informal and were conducted by only a few departments; but later, they became more general and more formal,--the students often being given printed descriptions of

the works to be inspected and of the things that should be noticed. These trips were optional with the students; but usually all, or practically all, participated.

In 1915, however, the senior inspection trip was made a requirement for graduation from the College of Engineering. The first of such trips, made on November 22-24, 1916, included inspections in Chicago and nearby points. A printed itinerary containing general directions and the schedules for the trip, was presented to each student before he left Urbana. The practice of scheduling the trip for visits to points of interest in Illinois, Wisconsin, and Missouri, and of printing the itinerary, has continued to the present time except when emergency conditions prevailed, as for example during the years 1931-32 to 1934-35 inclusive when the depression prevailed and during 1942-45, the period of World War II. The trips have been generally scheduled for about the middle of the first semester, and have usually lasted three or four days, although some departments sometimes have taken a week. Each student pays all of his expenses on the trip, while the University pays the expenses of one instructor for each fifteen students or fraction more than eight.

The value of these inspections lies in the training which the students get when they observe the extent of industry and the systematic processes involved in large-scale production. To those students that live outside of industrial regions and even to those that have grown up in them, the trip presents opportunities for visualizing in operation what they have only been able to read about. The itineraries include a great variety of plants or establishments of particular interest to departmental groups, comprising the best from the instructional viewpoint. The managements of these plants generally make unusual preparation to receive their guests, taking every precaution to offer the best instruction and protection possible. Some time after his return to the campus, each student is required to prepare and present to his department a rather comprehensive report outlining in some detail an account of his observations and impressions of the trip.

Freshmen Engineering Lecture.--The plan inaugurated in the fall of 1909 of calling all engineering freshmen together once a week,-at 10:00 o'clock on Wednesdays,-- to

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listen to lectures upon some general feature of engineering education or engineering practice, has been continued to the present time,[1] and has proved itself to be of great value. The lectures have sometimes been given by members of the faculty, sometimes by visiting professors, and often by a practicing engineer invited to come to the University especially for the occasion. This weekly assembly gives an opportunity to announce instructions concerning general administrative matters; but the chief purpose is to give the freshman a knowledge of some of the great accomplishments of engineers, to acquaint him with the methods and machines employed in engineering construction, and to give him an opportunity to hear instructors from other departments, and to hear prominent engineers in practice. In other words, to develop a sort of professional atmosphere for the benefit of the student body. These lectures are useful to some freshmen, too, in helping them to orient themselves and to determine which branch of engineering they will study after the freshman year, since freshman curricula of most of the engineering departments are identical during the first year.

Beginning in the second semester of 1921-22, the departments took over about nine or ten of the periods allotted to Engineering Lecture,-usually from about the first week in March to the first week in May,--in order to familiarize the students with the scope of the work in its different branches. Some of these periods have been occupied by inspection trips to the various laboratories in the College of Engineering. Others have been used by instructors to outline the different phases of work in their respective divisions.

In the beginning, these assemblies for Freshmen Lectures were scheduled to meet in the Chapel of University Hall. Later, they have been held in the University Auditorium on the South Campus, and have been in charge of the Assistant or Associate Dean of the College.

1. The lectures have been discontinued since September, 1941, but will be resumed as soon as the war is over.

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f. COURSES AND CURRICULA FROM 1915 TO 1922

New Curricula and Curricular Changes.-The rapid development in the field of applied science broadened the opportunities for men engaged in engineering practice and provided lines of specialization that were undreamed of when the University was founded in 1868. Mechanical engineering expanded to include not only steam power problems, but also internal combustion engines, aeronautics, heating, ventilating and air-conditioning, refrigeration, and thermodynamics. Civil engineering extended its fields to include sanitary and water-supply engineering, railway and highway engineering, structural engineering, and hydrology. Electrical engineering grew until it comprised work in radio, telephone, telegraph and other forms of communication, illumination, high-frequency currents, as well as electric power production. Ceramic engineering outgrew the field of pottery-making as designated by the term ceramics, to cover such other lines of industry as the production of structural clay products, enamel and glass wares, abrasion equipment, cements, and a variety of electrical and thermal insulating materials.

To satisfy the imperative demands arising from incessant industrial and professional improvement, instruction in these new fields called for many specialized courses not all of which could by any means be included in a four-year curriculum. The development of these new courses made the work of formulating engineering curricula increasingly difficult through the years. The urge to include the many non-technical subjects of growing interest such as those courses in the fields of economics and business administration, english composition and speech, had to be compromised with the desire to inject the many specialized technical subjects that demanded consideration; for the four-year course was too short to contain all of the subjects that seem appropriate for study as the basis for an engineering career. Some of these curricula are outlined in the following pages.

Options in the Civil Engineering Curriculum, 1915-1916--For the first time in Civil Engineering, the curriculum of 1915-16 offered three options for the work in the senior year. These included the General Civil Engineering option, Structural Engineering option, and Highway Engineering option. Through the choice of such

consistently-arranged programs, students could specialize more systematically than they would be expected to do under the provision of free electives only. The separate curriculum in railway civil engineering which had been in existence since 1907, already made special provision, of course, for students desiring to specialize in this particular field.

The Curriculum in Ceramic Engineering, 1915-16.--In the register of 1915-16 when the Department was transferred to the College of Engineering, the Register contained the following curriculum in Ceramic Engineering:

REVISED CURRICULUM IN CERAMIC ENGINEERING

FIRST YEAR

FIRST SEMESTER	Hrs.	SECOND SEMESTER	Hrs.
Chem. 1a or 1b,-Inorganic Chemistry	3 or 4	Chem. 4-Qualitative Analysis	4
Engineering Lecture	0	Engineering Lecture	0
G.E.D. 1-Elements of Drafting	4	G.E.D. 2 - Descriptive Geometry	4
Math. 2-Collegiate Algebra	3	Math. 6-Analytical Geometry	5
Math. 4-Trigonometry	2	Mil. 1-Drill Regulations	1
Mil. 2a-Military Drill	1	Mil. 2b-Military Drill	1
Phys. Tr. 1 and 1a-Gymnasium and Hygiene	1	Phys. Tr. 2-Gymnasium	1
Rhet. 1-Rhetoric and Themes	3	Rhet. 2-Rhetoric and Themes	3
Total	17 or 18	Total	19

Summer Reading 50 Points

SECOND YEAR

Chem. 5a-Quantitative Analysis	5	Cer. 1-Ceramic Materials	3
Math. 7-Differential Calculus	5	Chem. 5b-Quanitative Analysis	5
Min. 3-Mining Principles	2	Math. 9-Integral Calculus	3
Mil. 2c-Military Drill	1	Mil. 2d-Military Drill	1
Phys. 1a-Physics Lectures	3	Phys. 1b-Physics Lectures	2
Phys. 3a-Physics Laboratory	2	Phys. 3b-Physics Laboratory	2
		T. and A.M. 20 -Analytical Mechanics	3
Total	18	Total	19

Summer Reading 50 Points

THIRD YEAR

Cer. 2-Winning and Preparation of Clays	3	Cer. 5-Ceramic Bodies	5
Cer. 3-Industrial Calculation	3	Cer. 10-Cements	3
Chem. 65-Gas and Fuel Analysis	2	Cer. 12-Design and Shaping	3
Language	4	C. E. 76-Surveying	2
T.and A.M.21-Analytical Mechanics	2	Language	4
T.and A.M.25-Resistance of Materials	4		
Total	18	Total	17

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

FOURTH YEAR

Cer. 4-Drying and Burning	4	Cer. 8 - Glass	2
Cer. 6 - Glazes	5	Cer. 9 - Ceramic Construction	4
Cer. 17 - Silicates	3	Ceramic Thesis or Technical Elective	3
Geol. 13a-Engineering Geology	3	Geol. 13b-Engineering Geology	3
Non-Technical Elective	3	M.E. 62-Mechanical Engineering Laboratory	3
Total	18	Total	15

The Department thus afforded an opportunity for training in a field which was of growing importance, and which stood to be greatly benefited through the utilization of trained engineers and through the knowledge gained from scientific research. There were relatively few institutions which offered work in ceramic engineering at that time, and this department at the University of Illinois was probably the best equipped and best prepared for the instruction of students and for research in the science of this subject of any university or college in the world. As stated in the 1915-16 issue of the Register; "The courses offered by the Department of Ceramic Engineering are designed to give a technical knowledge of the composition and properties of materials used in the manufacture of claywares, cements, glasses, and enamels, and to acquaint the student with the construction, equipment, and operation of ceramic plants."[1]

The Curriculum in Ceramics.*The curriculum in Ceramics was dropped in 1915-16 when the work in Ceramics and Ceramic Engineering was transferred to the College of Engineering. It was revived, however, in 1921-22, and appeared as follows:

FIRST YEAR

FIRST SEMESTER		SECOND SEMESTER	
Chem. 1a or 1b-Inorganic Chemistry	3 or 4	Chem. 3a-Qualitative	5
Math. 2-College Algebra	3	Math. 6a-Analytical Geometry	5
Math. 4-Trigonometry	2	French or German	4
French or German	4	Rhet. 2 - Rhetoric and Themes	3
Rhet, 1-Rhetoric and Themes	3	Phys. Ed. 2-Gymnasium	1
Phys. Ed, 1-Gymnasium	1/2	Mil.-Pract. Instruction	1/2
Hygiene 1-Hygiene (Men)	1/2	Mil. Theoret. Instruction	1/2
Mil. - Pract. Instruction	1/2		
Mil. - Theoret. Instruction	1/2		
Total	17 or 18	Total	18

1. Page 286

SECOND YEAR

Chem. 5a-Qualitative Analysis	5	Chem. 5b-Quantitative Analysis	5
Math. 8a-Differential Calculus	3	Math. 8b-Integral Calculus	3
Phys. 1a-Physics Lecture	3	Phys. 1b-Physics Lectures	2
Phys. 1b-Physics Laboratory	2	Phys. 3b-Physics Laboratory	2
Cer. 1-Ceramic Materials	3	Cer.2-Winning and Preparation of Clays or elective	3
Military	1	Military	1
		Elective	3
Total	17	Total	19

THIRD YEAR

Cer. 12-Designing and Shaping	3	Cer. 3-Industrial Calculation	3
Chem.65-Gas and Fuel Analysis	2	Cer.5-Ceramic Bodies	5
Geol.20-General Mineralogy	3	Chem. 9-Organic Chemistry	3
Chem.7-Metallurgy	3	Chem.9c-Organic Chemistry Laboratory	2
E.E. 8-Elect.Currents(or elective)	3	Chem.31-Physical Chemistry	3
E.E. 68-Electrical Eng. Lab. (or elective)	1	Chem.33-Physical Chemistry Lab.	2
Elective	3		
Total	18	Total	15

FOURTH YEAR

Cer. 4c-Drying and Burning	5	Chem.6-Chem. Technology	3
Cer. 6-Glazes	6	Chem. 61-Industrial Chem. Lab.	3
Cer.17a-Physical Chem. Problems	1	Thesis	4 or 5
Cer.99-Inspection Trip	0	Elective	6 or 5
Elective	6		
Total	18	Total	16

The object of this curriculum was to prepare students to become ceramic chemists or technologists in charge of laboratories for the control of processes, for testing and investigating, and for research rather than to become operators of clay-working plants, as was the purpose of the curriculum in Ceramic Engineering. The first year the curriculum was offered, eighteen students enrolled in it.

The Curriculum in Engineering Physics.--The curriculum in General Engineering Physics, or Engineering Physics as it was called later, was introduced in 1917-18. It was composed of fundamental courses already given in mathematics, chemistry, mechanics, electrical and mechanical engineering, rhetoric and language requirements, and the usual electives required in the College of Engineering. The object of the curriculum as stated in University publications issued at that time was to fit persons for investigations of general engineering problems calling for a knowledge of physics and mathematics, or to prepare them to teach physics and allied

subjects in engineering colleges. The number of students in this curriculum has not been great. In the first year there were two and the following year five, one of whom was graduated. The University of Illinois was a pioneer in offering such a program, and several other institutions began shortly afterward to schedule such curricula. As listed in The Register, it was presented in the following arrangement of subjects.

FIRST YEAR

FIRST SEMESTER	Hrs.	SECOND SEMESTER	Hrs.
Chem. 1a or 1b-Inorganic Chemistry	3 or 4	Chem. 4-Inorganic Chemistry	4
G.E.D. 1-Elements of Drafting	4	G.E.D. 2-Descriptive Geometry	4
Math. 2-Advanced Algebra	3	Math. 6-Analytical Geometry	5
Rhet. 1-Rhetoric and Themes	3	Rhet. 2-Rhetoric and Themes	3
Phys.Tr. 1 and 1a-Gymnasium and Hygiene	1	Phys. Tr. 2-Gymnasium	1
Mil. 1a-Military Drill	1/2	Mil. 2a-Military Drill	1/2
Mil. 1b-Military Theory	1/2	Mil. 2b-Military Theory	1/2
Engineering Lecture	0	Engineering Lecture	0
Math. 4. & Trig.	2		
Total	17 or 18	Total	18

Summer Reading 50 Points

SECOND YEAR

German 1 -Elementary German or French 1a	4	Math. 9-Integral Calculus	3
Math. 7-Differential Calculus	5	German 3-Narrative Prose or French	4
Chem.5d-Elementary Quantitive Anal.	4	Chemistry (elective)	3
Phys. 1a-Physics Lectures	3	Phys. 1b- Lectures	2
Phys. 3a-Physics Laboratory	2	Phys. 3b- Physics Laboratory	2
Mil. 3a-Military Drill	1/2	T. and A.M. 20-Analytical Mechanics	3
Mil. 3b-Military Theory	1/2	Mil. 4a-Military Drill	1/2
		Mil. 4b-Military Theory	1/2
Total	19	Total	18

Summer Reading 50 Points

THIRD YEAR

Math. 9a-Advanced Calculus	2	Phys. 4b - Electrical Measurements	2
Phys. 4a-Electrical Measurements	2	Phys. 17 - Lighting or 23-Sound	3
Phys. 16 - Heat	3	M. E. 62 - Steam Engines, etc.	3
E. E. 25 - D. C. Theory	4	E. E. 26 - Alternating Current Theory	4
E. E. 75 - D. C. Laboratory	2	E. E. 76 - Alternating Current Lab.	2
T. & A.M. 25-Resistance of Materials	4	Elective	3- 4
Total	17	Total	17- 18

FOURTH YEAR

Phys. 14a - Dynamics	3	Math. 17 - Differential Equations	3
Phys. 31a - Special Investigation	3	Phys. 24 - Properties of Matter or Phys. 30-Introduction to Theoretical Electricity	3
Math. 16-Advanced Cal. and Differential Equations	3	Phys. 31b - Thesis	3
M. E. 11 - Thermodynamics	3	Chem. 31 - Physical Chemistry	4
Physics Colloquium	0	Elective	3- 4
Elective	3- 5		
Total	15-17	Total	16-17

C. COURSES AND CURRICULA FROM 1922 to 1945

a. CURRICULA, 1922 to 1941

Changes in Language Requirements and in Hours for Non-Technical Electives.-Beginning in September, 1922, the engineers were no longer required to take the formerly-prescribed eight hours of language, provided they had had one year of high-school language to substitute for the four-hour course given each semester. In addition, the fourth year of English was considered equivalent to the one year of high-school language. This arrangement made provision for students to take additional technical electives; but as an offset to this advantage, the non-technical electives were reduced from nine to six hours in most curricula.

The Curriculum in Gas Engineering.-A curriculum in Gas Engineering was provided in 1922-23. This was introduced at the request of the gas industry of Illinois for the preparation of men who desired to engage in the manufacture and distribution of all kinds of gaseous fuel, in the coking of coal, and in the preparation and utilization of the by-products of coal. This curriculum was intended to fit men for operating positions about a gas or coke plant rather than for positions in the laboratory, where the work is more distinctly of a chemical nature. All of the courses offered in the curriculum with the exception of thirteen credit hours during the senior year, were already being given by the University, for the new curriculum was essentially an adaptation of the courses in Chemical Engineering with additional subjects from the Departments of Mechanical Engineering, Mining Engineering, and Physics. The administration of the curriculum was placed under the Department of Mining Engineering, with the following subjects arranged for the four-year program:

FIRST YEAR

FIRST SEMESTER	Hrs.	SECOND SEMESTER	Hrs.
Chem. 1a or 1b-General Chemistry,	3 or 4	Chem. 3a-Inorganic and Qualitative	5
Math. 2 - College Algebra	3	Math. 6a-Analytic Geometry	4
Math. 4 - Trigonometry	2	German 6 - Advanced	4
G. E. D. 1	4	Rhet. 2 - Rhetoric and Themes	3
Rhet. 1 - Rhetoric and Themes	3	Phys. Ed. 2-Gymnasium Practice	1
Phys. Ed. 1 - Gymnasium Practice	1/2	Mil. - Military Drill and Theory	1
Hyg. 1 - Hygiene (Men)	1/2	Eng. Lecture	0
Mil. - Military Drill and Theory	1		
Eng. Lecture	0		
Total	17 or 18	Total	18

SECOND YEAR

Chem. 5a- Quantitative	5	Math 8b - Integral Calculus	3
Math. 8a - Differential Calculus	3	Phys. 1b - General Physics	2
Phys. 1a - General Physics	3	Phys. 3b-Physical Measurements	2
Phys. 3a - Physical measurements	2	Chem. 9 - Organic	3
Ger. 4 - Prose Reading	4	Chem. 9c - Organic Laboratory	2
Mil. - Military Drill and Theory	1	T. & A.M. 20-Analytical Mechanics	3
		Mil. - Military Drill and Theory	1
	18		16

THIRD YEAR

T. & A.M.25-Resistance of Mat'ls	4	T.&A.M.26-Analyt.Mech. and Hydraul.	4
E.E.8-Electric Currents and App.	3	Chem. 31 - Physical Chemistry	3
E.E.68 - Elec. Eng. Laboratory	1	Chem. 33 - Physical Chem. Laboratory	2
M.E. 1 - Steam and Air Machinery	3	M. E. 15 - Heat Engineering	3
M. E. 13 - Thermodynamics	3	Chem. 65b - Gas Analysis	3
Chem. 7 - Metallurgy	3	Phys. 16 - Heat Phenomena	3
Chem. 14d-Organic Chem. Lab	2	Phys. 36 - Heat Measurements	1
	19		19

FOURTH YEAR

Special-Gas Engineering	6	Special-Gas Engineering	7
Min. 9 - Coal Preparation	3	Cer. 20 - Refractory Materials	2
Chem. 77-Classification and Theory of Carbonization	2	Min. 64 - Coal Mining Laboratory	3
M. E. 61 - Power Measurement	2	Chem. 76 - Tars and Oils	3
Non-technical Elective	3	Non-technical Elective	3
Inspection Trip	0		
	16		18

After the course had been offered for ten years, it was found that only two students had ever graduated and that only one or two others had ever gone beyond the freshman year. On account of this lack of interest, there was no justification for engaging a staff to handle the work, and the curriculum was dropped at the end of 1932-33.

General Engineering.-A non-specialized engineering curriculum was prepared in a formal communication from Doctor Carman, Professor of Physics, at the time the

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general revision of the curricula was under consideration during 1911-13. Professor Carman suggested that such a course would prepare men as managers of large undertakings of an industrial or engineering character, for which a specialized curriculum was not required; that such a curriculum would be a good preparation for a general business career; and also that it might be followed by a fifth specialized year of study. The Committee on Revision of Curricula recommended such a curriculum, and the faculty adopted it; but at the request of the President it was not put into effect at that time.

Under date of May 9, 1919, Mr. S. T. Henry, an engineering graduate of 1904 and President of the Allied Machinery Company, in a letter to Dean Richards, suggested the advisability of an engineering curriculum that would prepare engineering students to become salesmen in foreign countries.

Prompted by the suggestions of both Professor Carman and Mr. Henry, and somewhat in line with their recommendations, there was presented for consideration a non-specialized general engineering curriculum leading to the degree of B. S. in General Engineering intended for students who might not wish to undertake a program of training for the more specialized fields of engineering practice, but who, however, might wish to secure fundamental training in the principles of engineering theory in order to ally themselves with industrial and commercial developements in the fields of management, operation, and construction. The curriculum approved by the Board of Trustees in 1921 provides a fundamental engineering training with moderate emphasis on design and with some stress given to the business side of engineering and industry through sequences of courses in economics, money and banking, labor problems, etc. The free electives provide a means for the development of any special interests the student may have. The studies in the first two years are not materially different from most of the other curricula in the College of Engineering, the only changes being in the substitution of economics for foreign language and the elimination of shop work with the exception of foundry and one semester of machine shop. In the junior and senior years, the students receives instruction in graphic statics, direct and alternating current, thermodynamics,

steam engines, and two years of a language or nontechnical elective and two years of economics.

The administration of this curriculum has so far been under the direction of the Assistant Dean or Associate Dean of the College of Engineering.

The First Curriculum in General Engineering-The curriculum in General Engineering established in 1923-24 appeared as follows in the Register for that year:

FIRST YEAR

FIRST SEMESTER	Hours	SECOND SEMESTER	Hours
Chem.1a or 1b-Inorganic Chemistry	3 or 4	Chem. 4 - Qualitative Analysis	4
G.E.D.1-Elements of Drafting	4	G. E. D.2- Descriptive Geometry	4
Math. 2 - Advanced Algebra	3	Math. 6 - Analytical Geometry	5
Math. 4 - Trigonometry	2	Rhet. 2 - Rhetoric and Themes	3
Rhet. 1 - Rhetoric and Themes	3	Phys. Ed. - Gymnasium Practice	1
Phys. Ed. 1- Gymnasium Practice	1/2	Mil. 2a and 2b, 12a and 12b, 32a and 32b, or 52a and 52b, - Military Drill and Theory	1
Hyg. 1 - Hygiene (men)	1/2	Engineering Lecture	0
Mil.1a and 1b,11a and 11b, 21a and 21b, 31a and 31b, 51a and 51b-Mil, Drill and Theory	1		
Engineering Lecture	0		
Total	17 - 18	Total	18

SECOND YEAR

Econm. 1 - Principles of Economics	5	Econ. 3 - Money, Credit and Banking	3
Math. 7 - Differential Calculus	5	Math. 9 - Integral Calculus	3
M. E. 85 - Pattern and Foundry Lab.	3	C.E.34-Plain and Topographic Surv.	3
Phys. 1a - Physics Lectures	3	Phys. 1b-Physics Lectures	2
Phys. 1b - Physics Laboratory	2	Phys. 3b-Physics Laboratory	2
Mil. 3a and 3b, 13a and 13b, 23a and 23b, 33a and 33b, or 53a and 53b - Mil. Drill and Theory	1	T. & A.M. 20 - Analytical Mech.	3
		Mil. 4a and 4b, 14a and 14b, 24a and 24b, 34a and 34b, or 54a and 54b-Mil. Drill and Theory	1
Total	19	Total	17

THIRD YEAR

Econm. 35 - Corporations	3	Business Law - Contracts etc.	3
E.E. 11 - D. C. Apparatus	3	E. E. 12 - A. C. Apparatus	3
E.E. 61 - D. C. Laboratory	1	E. E. 62 - A. C. Laboratory	1
Language or Approved Elective	4	Language or Approved Elective	4
M.E.87-Machine and Forge Laboratory	3	M. E. 10 - Thermodynamics	3
T. & A.M. 25 - Resistance of Materials	4	T. & A.M. 26 - Analytical Mech. and Hydraulics	4
Total	18	Total	18

FOURTH YEAR

Chem.7-Metallurgy of Iron and Steel	3	Math.23-Averages and Math. in Investments or Geol. 43 - Engineering Geology	3
Econ. 41 - Labor Problems or Econm.29-Foreign Commerce and Commercial Policies	3	Econ. 42 - Labor Organizations and	

cont'd.

Language or Approved Elective	4	Employer Associations or	
M. E. 3 - Steam Eng.	3	Econ. 43 - Personnel Administration	3
C. E. 88 - Stresses in Structures	4	M. E. 64 - Power Measurements	3
C. E. 99 - Inspection Trip	0	Language or Approved Elective	4
		C. E. 90 - Structural Design	4
Total	17	Total	17

The successful completion of this program of study, designed to provide young men with a substantial basic knowledge regarding the principles of engineering design and construction and plant organization, management, and operation, has enabled the students to take positions where they could be of immediate service to employers either in the engineering or the business divisions of productive enterprise.

Curriculum in Municipal and Sanitary Engineering, 1925-26.-When Professor Talbot was retired from active administrative duties in 1926, the registration of students enrolled in the Department of Municipal and Sanitary Engineering was light; and as there was little prospect of improvement in that direction, the Department was discontinued, and the curriculum as outlined below, was modified to become an option in Civil Engineering under the administration of that Department.

FIRST YEAR

FIRST SEMESTER		SECOND SEMESTER	
Chem. 1a or 1b - Inorganic Chemistry	3 or 4	Chem. 4-Qualitative Analysis	4
G.E.D. 1 or 4-Elements of Drafting	4	G.E.D.2-Descriptive Geometry	4
Math.1a-Methematical Analysis or	5	Math.1b-Mathematical Analysis or	5
Math 2 - Advanced Algebra and	3	Math 6. - Analytic Geometry	5
Math.4 or 5-Trigonometry	2	Rhet. 2 - Rhetoric and Themes	3
Rhet. 1 - Rhetoric and Themes	3	Phys. Ed. 12, 13, 14, or 15 - Physical Education	1/2
Phys. Ed. 31 - Physical Education	1/2	Hyg. 3 - Hygiene and Sanitation	1/2
Hyg. 1 - Hygiene and Sanitation(men)	1/2	Military Drill and Theory	1
Military Drill and Theory	1	Eng. Lecture	0
Eng. Lecture	0		
Total	17 or 18	Total	18

SECOND YEAR

C. E. 27 - Plane Surveying	3	C. E. 28 - Higher Surveying	3
Language	4	Language	4
Math. 7 - Differential Calculus	5	Math. 9 - Integral Calculus	3
Phys. 1a-Lectures	3	Phys. 1b-Lectures	2
Phys. 3a-Laboratory	2	Phys. 3b-Laboratory	2
Phys. Ed. 33 - Physical Education	1/2	T. & A.M. 20 - Analytical Mech.	3
Military Drill and Theory	1	Phys.Ed. 22,23,24,25,26,or 27-Physical Education	1/2
		Military Drill and Theory	1
	18½		18½

THIRD YEAR

Bact. 6 - Bacteriology	2½	C. E. 52 - Roads and Pavements	3
Chem. 10b - Water Analysis	2½	C. E. 60 - Structural Stresses	4
C. E. 53 - Railroad Surveying	3	C. E. 62 - Structural Details	2
T. & A.M. 21 - Analyt. Mech.	2	M. E. 2 - Steam Engineering	3
T. & A.M. 29 - Resistance of Mat.	5	T. & A.M. 10 - Hydraulics	3
Non-Technical Elective	2	Non-technical Elective	2
	17		17

FOURTH YEAR

C. E. 75 - Masonry Construction	3	C. E. 80-Contracts and Specifications	2
C. E. 95 - Plain Concrete	2	E.E. 2 - Elementary Elect. Eng.	3
C. E. 81 - Reinforced Concrete	2	M. & S. E. 3 - Sewerage	3
M. E. 61 - Power Measurement	2	M. & S. E. 6b -Water Purification and Sewage Disposal	2
M. & S.E. 2-Water Supply Engineering	4	M. & S.E. 9 - Hydraulic Design and Construction	2
M. & S.E. 6a-Water Purification and Sewage Disposal	3	M. & S.E. 98-Thesis or Approved El.	3
M. & S.E. 99 - Inspection Trip	0	Non-technical Elective	2
Non-technical Elective	2		
	18		17

Civil Engineering Curricula between 1926 and 1931.-After an Hydraulic option had been added to the fourth year of the Civil Engineering curriculum in September 1924, and after the Sanitary option was added in September, 1926, the revised curriculum for this Department in 1926-27 appeared as follows with the five optional programs for the work of the senior year:

FIRST AND SECOND YEAR

Same as Municipal and Sanitary Engineering, 1925-26

THIRD YEAR

FIRST SEMESTER	S.H.	SECOND SEMESTER	S.H.
C. E. 51 - Railroad Surveying	5	C. E. 54 - Roads and Pavements	4
C. E. 95 - Plain Concrete	2	C. E. 60 - Structural Stresses	4
T. & A.M. 21, Analytical Mechanics	2	C. E. 62 - Elementary Structural Design	2
T. & A.M. 29 - Resistance of Materials	5	C. E. 81 -Theory of Reinforced Con.	2
M. E. 1 - Steam and Air Machinery	3	T. & A.M. 10 - Hydraulics	3
		Non-Technical Elective	2
Total	17	Total	17

FOURTH YEAR

I. GENERAL OPTION

C. E. 75 - Masonry Construction	3	C. E. 72 - Sewerage	3
C. E. 71 - Water Supply Eng.	4	C. E. 80 - Contracts and Spec.	2
C. E. 85 - Structural Design	5	C. E. 82 - Structural Design	4
C. E. 99 - Inspection Trip	0	C. E. 84 - Valuations and Rates	2
Non-Technical Elective	3	E. E. 2 - Elem. Elec. Eng.	3
Technical Elective	3	Technical Elective	3
Total	18	Total	17

II. STRUCTURAL OPTION

C.E.	71	Water Supply Eng.	4	C.E. 72	Sewerage	3
C.E.	84	Valuations and Rates	2	C.E. 75	Masonry Construction	3
C.E.	85	Structural Design	5	C.E. 80	Contracts and Specif.	2
C.E.	63	Statically Ind.Structures	3	C.E. 82	Structural Design	4
C.E.	99	Inspection Trip	0	C.E. 64	Statically Ind. Strs.	3
Non-Tech.		Elective	3	E.E. 2	Elem. Elec. Eng.	3
		Total	17			18

III. HIGHWAY OPTION

C.E.	57	Hydrology	2	C.E. 72	Sewerage	3
C.E.	71	Water Supply Eng.	4	C.E. 75	Masonry Construction	3
C.E.	85	Structural Design	5	C.E. 80	Contracts and Specif.	2
C.E.	55	Highway Design.	4	C.E. 82	Structural Design	4
C.E.	99	Inspection Trip	0	C.E. 94	Highway Administrat	3
Non-Tech		Elective	3	C.E. 96	Road Materials	2
		Total	18		Total	17

IV. HYDRAULIC OPTION

C.E.	57	Hydrology	2	C.E. 72	Sewerage	3
C.E.	71	Water Supply Eng.	4	C.E. 79	Water Power Engineering	3
C.E.	75	Masonry Construction	3	C.E. 78	Drainage Engineering	3
C.E.	85	Structural Design	5	C.E. 80	Contracts and Spec.	2
C.E.	99	Inspection Trip	0	C.E. 82	Structural Design	4
Non-Tech.		Elective	3	E.E. 2	Elem. Elect. Eng.	3
		Total	17		Total	18

V. SANITARY OPTION

Bact.	6	Bacteriology	$2\frac{1}{2}$	C.E. 75	Masonry Construction	3
Chem.	10b	Chem. of Water and Sewerage	$2\frac{1}{2}$	C.E. 89	Sewage Treatment	3
C.E.	73	Structural Design	4	C.E. 72	Sewerage	3
C.E.	71	Water Supply	4	C.E. 76	Structural Design	2
C.E.	80	Contracts and Spec.	2	E.E. 2	Elem. Elect. Eng.	3
C.E.	87	Water Purification	3	Non-Tech.	Elective	3
C.E.	99	Inspection Trip	0			
		Total	18		Total	17

This curriculum in civil engineering offers a systematic training in the principles underlying the design and construction of bridges, buildings, dams, retaining walls, and other structures; railways and highways; water-supply and sewage disposal systems; hydraulic engineering works, etc. Opportunity is offered in the senior year for a certain amount of specialization in some of the more important branches of civil engineering by the options in structural engineering, highway engineering, hydraulic engineering, and sanitary engineering, which bring the students into contact with some of the more difficult problems encountered in engineering practice.

The curriculum in Civil Engineering underwent several changes from 1927 to 1930. Besides, an option was provided in city planning. The curriculum as given in 1930-31 was as follows:

FIRST YEAR

Same as 1925-26 except that Math. 1a and 1b were omitted.

SECOND YEAR

C. E. 27 Plane Surveying	3	C. E. 28 Topographic Surveying	3
Math. 7 Differential Calculus	5	Math. 9 Integral Calculus	3
Phys. 1a Physics Lecture	3	Phys. 1b Physics Lecture	3
C. E. 59 Bridge and Building Const., Foreign Language, or App. Elective	3	Phys. 3b Physics Laboratory	2
Physical Education	1/2	C. E. 40 Highway Construction	2
Military	1	C. E. 95 Plain Concrete	2
Physics 3a (Physics Lab)	2	T. & A.M. 1 Analytical Mechanics	2
		Physical Education	1/2
		Military	1
Total	17½	Total	18½

THIRD YEAR

C. E. 60 Structural Stres.	4	C. E. 37 Ry. and Hy. Surveying	4
C. E. 41 Roads and Pavements	2	C. E. 61 Elem. Str. Design	3
C. E. 42 Highway Lab.	1	C. E. 81 Reinforced Concrete	2
M. E. 1 Steam and Air Machinery	3	T. & A.M. 4 Hydraulics	2
T. & A.M. 2 Analyt. Mech.	3	T. & A.M. 64 Hydraulics Lab.	1
T. & A.M. 3 Resis. of Mat.	3	Geol. 43 Engineering Geol., Foreign Language or App. Elective	3
T. & A.M. 63 Matls. Test. Lab.	1	E. E. 2 Elem. Elect. Eng., Foreign Language, or Approved Elective	3
Total	17	Total	18

THIRD YEAR
CITY PLANNING OPTION

C. E. 60 Struct. Stes.	4	C. E. 37 Ry. and Hy. Surveying	4
C. E. 41 Roads and Pavement	2	C. E. 62 Elem. Str. Design	3
C. E. 53 Highway Lab.	1	C. E. 81 Reinforced Concrete	2
Hort. 37a City Planning	2	T. & A.M. 4 Hydraulics	2
A. E. 33 Arch. Drawing	3	T. & A.M. 64 Hydraulics Lab.	1
T. & A.M. 2 Analyt. Mech.	3	Hort. 37b City Planning	2
T. & A.M. 3 Resistance of Materials	3	A. E. 34 Arch. Design	3
Total	18	Total	17

FOURTH YEAR

C. E. 71 Water Sup. Eng.	4	C. E. 72 Sewerage	3
C. E. 82 Str. Design	4	C. E. 85 Structural Design	5
C. E. 99 Inspection Trip	0	Options (see below)	10 or 9
Options (see below)	9 or 10		
Total	17 or 18	Total	18 or 17

I General Option

C. E. 75 Masonry Const.	3	C. E. 84 Estimates and Costs	2
C. E. 80 Contracts and Spec.	2	Approved Elective	5
Non-Tech. Elective	4	Technical Elective	3
	9		10

II HIGHWAY OPTION

C. E. 55 Highway Design	4	C. E. 75 Masonry Construction	3
C. E. 57 Hydrology	2	C. E. 80 Contracts and Specifications	2
Non-Technical Elective	3	C. E. 94 Highway Administration	3
		C. E. 96 Road Materials	2
	9		10

III HYDRAULIC OPTION

C. E. 75 Masonry Const.	3	C. E. 78 Drainage Eng.	3
C. E. 80 Contracts and Spec.	2	C. E. 79 Water Power Eng.	3
C. E. 57 Hydrology	2	Non-Technical Elective	4
Approved Elective	2		
	9		10

IV SANITARY OPTION

C. E. 80 Contracts and Spec.	2	C. E. 75 Masonry Construction	3
Chem. 80a Chem. of Water and Sewage	5	C. E. 89 Sewage Treatment	3
C. E. 87 Water Purification	3	[1] Bact. 5a Bacteriology	3
	10		9

V STRUCTURAL OPTION

C. E. 80 Contracts and Spec.	2	C. E. 75 Masonry Constr.	3
C. E. 63 Stat. Ind. Stresses	3	C. E. 64 Stat. Ind. Stresses	3
C. E. 84 Estimates and Costs	2	Non-Technical Elective	4
Approved Elective	2		
	9		10

VI CITY PLANNING OPTION

Only students who had taken the special curriculum in the third year could elect this option.

C. E. 75 Masonry Construction	3	C. E. 80 Contracts and Spec.	2
Hort. 23a Landscape Des.	4	Hort. 23b Landscape Des.	4
Econ. 2 Elements of Economics	3	C. E. 92 Municipal Eng.	3
	10		9

The option in City Planning, started in 1931 for the benefit of landscape architects and civil engineers, was dropped at the end of 1938-39, on account of the lack of interest in the option and the inability of students taking it of finding practical employment along that line. C. E. 29, Municipal Transportation, a required course in that option, was discontinued.

1. It was recommended that Bact. 5a and 5b be taken in the third year in place of approved electives.

Curriculum in Architecture, 1929-30.-The following curriculum in Architecture is typical of those offered by the Department in the years before it left the College of Engineering in 1931 and became a member of the College of Fine and Applied Arts:

FIRST YEAR

FIRST SEMESTER	Hours	SECOND SEMESTER	Hours
Arch. 31 - Arch. and Freehand Drawing	4	Arch. 32 - Arch. and Freehand Drawing	4
G. E. D. 2 - Descriptive Geometry	4	Chem.2 or 3-Inorganic Chemistry 3 or	4
Math. 1a-Introd. to College Math. or	5	T. & A.M. 14 - Elementary Mechanics	4
Math. 2 - Advanced Algebra and . . .	3	Rhet. 2 - Rhetoric and Themes	3
Math. 4 or 5 - Trigonometry	2	Physical Education	1/2
Rhet. 1 - Rhetoric and Themes	3	Hyg. 3 - Hygiene and Sanitation(Men)	1/2
Physical Education	1/2	Military Drill and Theory	1
Hyg. 1-Hygiene and San. (Men)	1/2	Eng. Lecture	0
Military Drill and Theory	1		
Eng. Lecture	0		
Total	18	Total	16 or 17

SECOND YEAR

Arch 13-History of Architecture	2	Arch. 14 - History of Architecture	2
Arch. 23 - Freehand Drawing	2	Arch. 24-Freehand Drawing	2
Arch. 33 - Design	3	Arch. 34 - Design	3
Arch. 43 - Technology of Materials	3	Arch. 44 - Technology of Materials	3
Phys. 9a-Lectures	2	Phys. 9b - Lectures	2
Phys. 10a-Laboratory	2	Phys. 10b-Laboratory	2
T. & A.M. 15-Strength of Materials	3	T. & A.M. 16 - Strength of Materials	3
Physical Education	1/2	Physical Education	1/2
Military Drill and Theory	1	Military Drill and Theory	1
Total	18½	Total	18½

THIRD YEAR

Arch. 15 - History of Architecture	2	Arch. 16 - History of Architecture	2
Arch. 25 - Freehand Drawing	2	Arch. 26 - Freehand Drawing	2
Arch. 35 - Design	5	Arch. 36 - Design	5
Arch. 45 - Graphic Statics	3	Arch. 46 - Graphic Statics	3
Arch. 65 - Theory of Architecture	1	Arch. 55 - Building Sanitation	1
E. E. 90 - Lighting	1	Arch. 66 - Theory of Architecture	1
French or German	4	French or German	4
Total	18	Total	18

FOURTH YEAR

Arch. 27 - Freehand Drawing	2	Arch. 18 - History of Architecture	2
Arch. 37 - Design	7	Arch. 28 - Freehand Drawing	2
Arch. 68 - Specifications	3	Arch. 38 - Advanced Design or Thesis	7
Arch. 99 - Inspection Trip	0	Arch. 60a-Special Lectures	2
M.E.25-Heating and Ventilation	2	Arch. 67-Theory of Form and Color	2
Non-technical Elective	3	Non-technical Elective	2
Total	17	Total	17

Curriculum in Architectural Engineering, 1929-30.- The following curriculum in Architectural Engineering is typical of those offered by the Department of Architecture during the last few years when it was a member of the College of Engineering:

FIRST YEAR

FIRST SEMESTER	Hours	SECOND SEMESTER	Hours
Chem. 2 or 3-Inorganic Chemistry	3 or 4	Chem. 4 - Qualative Analysis	4
G.E.D. 1 or 4-Elements of Drafting	4	G.E.D.2-Descriptive Geometry	4
Math. 2 - Advanced Algebra	3	Math. 6 - Analytic Geometry	5
Math.4 or 5 - Trigonometry	2	Rhet.2-Rhetoric and Themes	3
Rhet. 1-Rhetoric and Themes	3	Physical Education	1/2
Physical Education	1/2	Hyg.3-Hygiene and Sanitation(men)	1/2
Hyg. 1-Hygiene and Sanitation(men)	1/2	Military Drill and Theory	1
Military Drill and Theory	1	Eng. Lecture	0
Eng. Lecture	0		
Total	17 or 18	Total	18

SECOND YEAR

Arch. 13 - History of Architecture	2	Arch. 14-History of Architecture	2
A.E. 33 - Architectural Drawing	3	A. E. 34 - Architectural Design	3
A. E. 43 - Technology of Materials	2	A. E. 44 - Technology of Materials	2
Math. 7 - Differential Calculus	5	Math. 9 - Integral Calculus	3
Phys. 1a-Lectures	3	Phys. 1b-Lectures	2
Phys. 3a-Laboratory	2	Phys. 3b - Laboratory	2
Physical Education	1/2	T. & A.M. 20 - Analytical Mechanics	3
Military Drill and Theory	1	Physical Education	1/2
		Military Drill and Theory	1
	18½	Total	18½

THIRD YEAR

Arch. 15-History of Architecture	2	Arch. 16 - History of Architecture	2
A. E. 35 - Architectural Design	3	A. E. 36 - Architectural Design	3
A. E. 45 - Graphic Statics	3	A. E. 46 - Graphic Statics	3
Language	4	Language	4
T. & A.M. 25 - Resistance of Materials	4	T. & A.M. 26 - Analytical Mechanics and Hydraulics	4
Non-Technical Elective	2		
	18		16

FOURTH YEAR

A.E.47-Architectural Engineering	5	A.E. 48-Architectural Engineering	5
A.E.57-Fireproof Construction	2	A.E.58-Fireproof Construction	2
A.E.99-Inspection Trip	0	A.E. 67 - Building Sanitation	2
E.E. - Lighting and Wiring	2	A.E. 68-Estimates and Specifications	4
M.E.23-Mechanical Equipment of Buildings	5	Technical Elective	5
Non-technical elective	3		
Total	17	Total	18

Engineering Physics.-The work in Engineering Physics was modified somewhat from time to time, and the following revised curriculum became effective in 1930-31:

FIRST YEAR

FIRST SEMESTER		SECOND SEMESTER	
Same as Architectural Engineering, 1930-31			

SECOND YEAR

German 1 or French or Approved Elective	4	German 2 or French, or Approved Elective	4
Math. 7- Differential Calculus	5	Math. 9 -Integral Calculus	3
Phys. 1a-Physics Lecture	3	M.E. 87- Machine Laboratory	3
Phys. 3a-Physics Laboratory	2	Phys. 1b-Physics Lecture	3
Physical Education	1/2	Phys. 3b-Physics Laboratory	2
Military Drill and Theory	1	T.&A.M. 21-Analytical Mechanics	2
Approved Elective	3	Physical Education	1/2
		Military Drill and Theory	1
Total	18½	Total	18½

THIRD YEAR

E.E. 25 - Direct-Current Apparatus	4	E. E. 26 - Alternating Currents	4
E. E. 75 -Elect.Eng. Lab.	2	E. E. 76 - Elec. Eng. Lab.	2
German 4 or French or Approved Elect.	4	German 4,5, or 6 or French, or Approved Elective	4
Phys. 14a - Dynamics	3	Math. 9a-Diff. and Integ.Calculus	2
Phys. 44a-Elec. and Mag. Meas.	3	Phys. 14b-Dynamics	3
Approved Elective	2	Phys.44b - Elec. and Mag. Meas.	3
Total	18	Total	18

FOURTH YEAR

Math.16-Adv.Calc.and Diff. Equations	3	Math. 17 - Differential Equations	3
M.E. 13 - Thermodynamics (M.E.10 or Phys.16 may be substituted	3	Phys. 30 - Introd.to Theoretical Elec.	3
Phys. 126 - Physics Colloquium	0	Phys. 126 - Colloquium	0
Tech. Option with at least 4 in Physics	11	Tech. Option with at least 3 hrs. in Physics	10
Total	17	Total	16

TECHNICAL OPTIONS

Chem. 40-Elem.Phys.Chem.Lect.	3	Chem. 42b - Elem. Phys. Chem. Lect.	3
Chem. 41-Elem.Phys.Chem.Lab.	1	Chem. 43b - Elem. Phys. Chem. Lab.	1
Chem. 44a - Adv. Phys. Chem.	2	Chem. 44 b - Adv. Phys. Chem.	2
Math.10-Theory of Equations or Math.22-Statistics	2	Math 20 - Graph.& Numer. Methods of Math 21 - Theory of Prob.	3
Phys. 20a - Light	2	ME. 10 - Thermodynamics	3
Phys. 22a - Light Laboratory	2	Phys. 16 - Heat	3
Phys. 23a - Sound Lecture	3	Phys. 20b - Light	2
Phys. 33 - Sound Laboratory	1	Phys. 22b - Light Lab.	2
Phys. 45 - Heat Radiation	3	Phys. 25 - Arch. Acoustics	2
Phys. 46a - Adv. Elec. Meas.	2	Phys. 36 - Heat Laboratory	1
Phys. 97 - Thesis	3-5	Phys. 46b-Adv. Elec. Meas.	2
T&AM. 3 - Resistance of Materials	3	Phys. 78 - X-Rays	3
T&AM. 63 - Materials Lab.	1	Phys. 98 - Thesis	3 -5
Approved Elective	3- 5	Approved Elective	3 -5

Chemistry 40 must be elected at some time.

The generous allowances made for free electives and for technical options in his own or allied departments, provided the student with splendid opportunity to specialize along lines of his own choosing in this particular field.

Civil Engineering Courses Renumbered in 1930-31.- In 1930-31 the Department of Civil Engineering renumbered all of its graduate and undergraduate courses so that groups of numbers could be assigned to divisions. This change was desirable because previously closely-related subjects were widely separated in the Register and Time Table,-a condition somewhat confusing to persons looking up courses within a certain division. In this arrangement, all numbers from 1 to 19 were assigned to surveying; from 20 to 29, to highway engineering; from 30 to 39, to materials; from 40 to 49, to sanitary engineering; from 50 to 59, to hydraulic engineering; from 60 to 69, to structural engineering; and from 90 to 99, to miscellaneous courses, such as Contracts and Specifications, Estimates and Costs, Thesis, and Inspection Trip. The numbers for Thesis and Inspection Trip, having corresponding numbers in other departments, were not changed.

Theoretical and Applied Mechanics Courses Renumbered in 1930-31.- During the year 1930-31, the Department of Theoretical and Applied Mechanics also renumbered its courses under the following arrangement: T. & A.M. 20 and 21, three hours and two hours respectively, were replaced by T. & A.M. 1 and 2, two hours and three hours respectively, - T. & A.M. I being devoted to statics and T. & A.M. 2 to kinematics and kinetics[1]. T. & A.M. 3 and 63 took the place of T. & A.M. 25,-T. & A.M. 3, three hours, being the same as the classroom work in T. & A.M. 25, and T. & A.M. 63, one hour, the same as the laboratory work in the old course. T.&A.M. 29 was abandoned. T. & A.M. 4 and 64 replaced T. & A.M. 10, - T. & A.M. 4, two hours, being the same as the classroom work given in T. & A.M. 10, and T. & A.M. 64, one hour, the same as the laboratory work in it. T. & A.M. 26 was abandoned and the departments concerned substituted T. & A.M. 2, 4, and 64, as the equivalent.

1. The principal purpose in making this change in the number of hours in these two courses was to relieve the work of the second semester of the sophomore year, but it had the additional advantage of making a more logical division of the subject matter in analytical mechanics.

Curriculum in Electrical Engineering, 1932-33.-The following curriculum in Electrical Engineering is typical of those offered by the Department during the early 1930's:

FIRST YEAR

FIRST SEMESTER	Hours	SECOND SEMESTER	
Chem. 2 or 3 - Inorganic Chemistry	3 or 4	Chem.4-Qualitative Analysis	4
G.E.D.1 or 4-Elements of Drafting	4	G.E.D 2 - Descriptive Geometry	4
Math.2-Advanced Algebra	3	Math 6a - Analytic Geometry	4
Math. 4 or 5 - Trigonometry	2	Rhet. 2-Rhetoric and Themes	3
Rhet. 1-Rhetoric and Themes	3	Physical Education	1/2
Physical Education	1/2	Hyg. 5 - Hygiene (men)	1/2
Military Drill and Theory	1/2	Military Drill and Theory	1
Engineering Lecture	0	Engineering Lecture	0
16½	17½		18½

SECOND YEAR

Language or Approved Elective	4	Language or Approved Elective	4
Math. 7 - Differential Calculus	5	Math. 9 - Integral Calculus	3
M. E. 85 or 87 - Pattern and Foundry or Machine Laboratory	3	M. E. 87 or 85-Machine or Pattern and Foundry Laboratory	3
Phys. 1a-General Physics	3	Phys. 1b-General Physics	3
Phys. 3a-Physics Laboratory	2	Phys. 3b-Physics Laboratory	2
Physical Education	1/2	T.A.M. 1-Analytical Mechanics(Stat.)	2
Military Drill and Theory	1	Physical Education	1/2
		Military Drill and Theory	1
	18½		18½

THIRD YEAR

E. E.25-Direct Current Apparatus	4	E.E.26-Alternating Currents	4
E.E. 75-Electrical Eng. Lab.	2	E.E. 76-Electrical Eng. Lab.	2
M.E.10-Thermodynamics or App. Elect.	3	Math.9a-Integral Calculus	2
Phys. 44a-Electrical and Magnetic Measurements	3	M.E.10-Thermodynamics or App.Elect.	3
T.A.M.2-Analytical Mech.(Dynamics)	3	Phys.44b-Electrical and Magnetic Measurements	3
T.A.M.4-Hydraulics	2	T.A.M.3-Resistance of Materials	3
T.A.M.64-Hydraulics Laboratory	1	T.A.M. 63-Res. of Materials Lab.	1
	18		18

FOURTH YEAR

E.E. 35 - A. C. Apparatus	4	E.E. 36 - A. C. Apparatus	4
E.E. 55 - Electrical Design	2	E.E. 56 - Electrical Design	4
E.E. 85 - Electrical Eng. Laboratory	2	E.E. 86 - Elec. Eng. Laboratory	2
E.E. 95 - Seminar	1	E.E. 96 - Seminar	1
E.E. 99 - Inspection Trip	0	E.E. 98 - Thesis or Tech. Elective	3
M.E. 3 - Steam Engineering	3	Approved Elective	2
M.E. 61 - Mech. Eng. Laboratory	2		
Non-technical Elective	3		
	17		16

In addition to those scheduled in the regular curriculum, there were many elective courses for both undergraduate and graduate students that were introduced from time to time in order to keep pace with the rapid development of the electrical industries. The most important of these related to power production and distribution and high-tension transmission; radio and telephone communication; electronics; and electric lighting.

Curriculum in Mechanical Engineering, 1932-33 - The following curriculum in Mechanical Engineering is typical of those offered by the Department during the early 1930's:

FIRST YEAR
Same as for Electrical Engineering in previous section.

SECOND YEAR

Language or Approved Elective	4	Language or Approved Elective	4
Math. 7 - Differential Calculus	5	Math. 9 - Integral Calculus	3
M.E. 85 -Pattern and Foundry Lab. or Approved Elective	3	M.E.85-Pattern and Foundry Laboratory or Approved Elective	3
Phys. 1a-General Physics	3	Phys. 1b-General Physics	3
Phys. 3a-Physics Laboratory	2	Phys. 3b-Physics Laboratory	2
Physical Education	1/2	T.A.M. 1-Analytical Mech.(Statics)	2
Military Drill and Theory	1	Physical Education	1/2
	$18\frac{1}{2}$	Military Drill and Theory	1
			$18\frac{1}{2}$

THIRD YEAR

M.E.13-Thermodynamics	3	M.E. 6 - Steam Engineering	4
M.E. 31 - Mechanics of Machinery	5	M.E. 16 - Thermodynamics	2
M.E. 87 - Machine Laboratory	3	M. E. 40 - Mechanical Eng. Design	3
T.A.M. 2 - Analytical Mech.(dynamics)	3	M.E. 64 - Mech. Eng. Laboratory	3
T.A.M. 3 - Resistance of Materials	3	M.E. 88 - Machine Laboratory	3
T.A.M. 63 - Resistance of Mat'ls Lab.	1	Non-technical Elective	2
	18		17

FOURTH YEAR

E.E. 11 - Direct Current Apparatus	3	E.E.12-Alternating Current Apparatus	3
E.E. 61 - Direct Current Laboratory	1	E.E.62-Alternating Current Lab.	1
M.E. 41 - M. E. Design	4	M.E.28 - Heating and Ventilation	4
M.E. 65 - M. E. Laboratory	3	M.E.52 - Power Plant Design	3
M.E. 89 - Heat Treatment of Metals or Non-technical Elective	3	M.E.89 - Heat Treatment of Metals or Non-technical Elective	3
Technical Option	3	Technical Option	3
M.E. 99 - Inspection Trip	0		
	17		17

Technical Options

M.E. 7-Internal Combustion Engines	M.E. 15-Heat Engineering
M.E. 17 - Refrigeration	M.E. 17 - Refrigeration
M.E. 33 - Aeronautical Engineering	M.E. 34 - Aeronautical Engineering
T.A.M. 41 - Advanced Mechanics	T.A.M. 42 - Engineering Materials
C.E. 89a - Structural Engineering	T.A.M. 44 - Testing Materials

The several technical options available for election by students enrolled in this Department along with the liberal allowances for free electives, provided opportunities for specialized training along a number of lines, such as heating, ventilating and air-conditioning; refrigeration; aeronautics; power-plant design and operation; or other phase of industrial enterprise in the field of mechanical engineering. The internal-combustion engine was a subject of intense interest at that time because of its possibilities in the various forms of transportation as well its adaptability to many types of stationary plants.

Curriculum in Mining Engineering, 1932-33.-The following curriculum in Mining Engineering was offered in 1932-33:

FIRST YEAR
Same as in Electrical Engineering

SECOND YEAR

Same as Mechanical Engineering except that Mining 61 and 62 are taken here instead of M.E. 85 and an approved elective.

THIRD YEAR

Chem.22-Elementary Quantitative Analysis	5	C.E. 88a - Mine Structures	2
Geol. 20 - Mineralogy	3	Geology 43-Engineering Geology	3
Min. 1 - Elements of Mining	3	M.E.62 - Mech. Eng. Laboratory	3
T.A.M.2-Analytical Mech.(Dynamics)	3	Min. 4-Mining Methods	3
T.A.M.3-Resistance of Materials	3	Min.10-Electrical Engineering of Mines	3
T.A.M.63-Res. of Materials Lab.	1	T.A.M.4-Hydraulics	2
		T.A.M.64-Hydraulics Laboratory	1
	18		17

FOURTH YEAR

Coal Mining Option

Chem. 73a-Metallurgy	3	Min.15-Mine Ventilation	2
Min. 6-Mechanical Engineering of Mines	3	Min.20-Mine Ventilation Lab.	2
Min. 8-Mine Administration	3	Min.21-Examination,Valuation,and Reports	3
Min.9-Preparation of Coal and Ore	3	Min. 42-Mine and Metallurgical Design	2
Min. 13-Utilization of Fuels	3	Min. 64-Coal and Ore Preparation	3
Min. 41-Mine and Metallurgical Design	3	Min. 90-Metallurgical Reports	1

Min.99-Inspection Trip	0	Non-technical Elective	3
	18		16

Ore Mining Option

Same as Coal Mining Option except that Min. 69,-Fire Assaying, 2 hrs. was substituted for Min. 13, and Geol. 96-Economic Geology was substituted for Min.20.

Metallurgical Option

Same as Coal Mining Option except that Min. 69-Fire Assaying, was substituted for Min.6, and Min.16-Non Ferrous Ore Treatment, 5 hours, and Min. 18-Metallurgical Problems, 2 hours, were substituted for Min. 15, Min. 20, and Min. 21.

Curriculum in Agricultural Engineering.-In 1930-31, a committee consisting of Professor E. W. Lehmann of the College of Agriculture, Professor W. A. Foster of the Colleges of Engineering and Agriculture, and Professor W. C. Huntington of the College of Engineering, was appointed to consider the advisability of offering a curriculum in Agricultural Engineering; for the increased use of mechanical power and farm machinery in agricultural production had created the need for training of some men as specialists to serve as teachers, or as research or design workers in the engineering aspects of agricultural production. After some deliberation on the matter, the committee recommended that a curriculum be offered; and proposed the combination and arrangement indicated in a later section, the proposal having been adopted by the University authorities.

The scope of the ground covered by the curriculum may be visualized under four main headings: (1), Power and machinery, including consideration of the types available and applicable to farm life; the design and development of implements, machines, vehicles, and other equipment; and the development and use of various suitable materials of construction; (2), farm electrification,including the extension of electrical service to the rural areas; and the development and use of the electrical farm machinery and equipment involved in the program of more extensive utilization of electricity in agriculture; (3), farm buildings and other structures, including the design, location, and arrangement of farm structures of all kinds; the proper lighting, heating, and ventilating of farm buildings; and the provisions for refrigeration equipment, water supplies, and sewage-disposal structures; and (4), land reclamation and use, including irrigation, drainage, and soil conservation, soil erosion, flood control, land clearing, and general farm

improvement.

The entire curriculum, still in effect essentially as prepared then, is fundamentally an engineering program, with moderate specialization beginning in the second year. Two options are provided;-one a power and machinery option, and the other a drainage and structures option. The College of Agriculture has an assortment of tractors, gas engines, and farm machinery for student use. Lighting units and water systems are provided in the home-equipment laboratory, and there are modern facilities for concrete construction.

The curriculum is administered by the College of Engineering, and the degrees are awarded upon certification by its faculty. The cooperative features described offer the student the dual advantages of close contact with the staffs of both colleges and afford training in both agricultural and engineering principles,-a prerequisite for successful production and operation.

First Curriculum in Agricultural Engineering. The curriculum adopted for instructional work in Agricultural Engineering, beginning in September, 1933 was as follows:

FIRST YEAR

FIRST SEMESTER		SECOND SEMESTER	
Same as Electrical Engineering.			

SECOND YEAR

Math. 7 - Differential Calc.	5	Math. 9 Integral Calculus	3
Phys. 1a - Physics Lectures	3	T.&A.M. 1 Analytical Mech.	2
Phys. 3a - Physics Laboratory	2	Phys. 1b - Physics Lectures	3
A.E. 2 - Power Machinery	3	Phys. 3b - Physics Laboratory	2
Botany 5 General Botany	3	A.E. 3 Gas Engines and Tractors	3
Ag. Exten.	0	Agronomy 25 Farm Crops	3
Military	1	Military	1
Phys. Ed.	1/2	Phys. Ed.	1/2
	$17\frac{1}{2}$		$17\frac{1}{2}$

THIRD YEAR

T.&A.M. 3 -Resistance of Materials	3	Agron. 28 Soils	5
T.&A.M. 63 Res. of Mat'l. Lab.	1	Option (see below)	13
Geol. 44 Agricultural Geology	3		
Options (see below)	11		
	18		18

MACHINERY AND POWER OPTION

A.E. 17 Harvesting Machinery	3	T.&A.M. 2 Analytical Mechanics	3
M.E. 31 Mechanics of Machines	5	M. E. 87 Machine Laboratory	3
M.E. 85 Pattern and Foundry	3	M. E. 40 Mechanical Eng. Design	3
		M. E. 10 Thermodynamics	3
		A.E. 51 Special Problem	1
	11		13

CONSTRUCTION AND DRAINAGE OPTION

C.E. 60a Bridge and Bldg. Con.	3	F.M. 12 Farm Utilities	2
C.E. 15 Surveying	3	C.E. 21 Highway Construction	2
C.E. 20 Highway Construction	2	T. & A.M. 4 Hydraulics	2
T. & A.M. 2 Analyt. Mechanics	3	T. & A.M. 64 Hydraulics Lab.	1
		C.E. 61a Structural Stresses	4
		C.E. 35 Plain Concrete	2
	11		13

FOURTH YEAR

Econ. 2 Elements of Economics	3	Options	16 or 17
F.O.&M. 1 Elements of Farm Operation and Man.	3		
F.M. 51 Special Problem or Approved Elective	2		
Option (see below)	11 or 12		
	19 or 18		16 or 17

MACHINERY AND POWER OPTION

FIRST SEMESTER		SECOND SEMSTER	
M. E. 41 - Mechanical Eng. Des.	4	E.E 12 Alternating Current Apparatus	3
E.E. 11 Direct Current App.	3	E.E. 62 Alternating Current Lab.	1
E.E. 61 Direct Current Lab.	1	M.E. 89 Heat Treatment of Metals	3
F.M. 28 Advanced Gas Eng. and Tractors	3	Group B. Elective	5
		Approved Elective	4
	11		16

CONSTRUCTION AND DRAINAGE OPTION

C.E. 52 Irrigation	2	C.E. 51 Drainage	3
C.E. 86 Structural Design	4	C.E. 90a Contracts and Spec.	2
C.E. 50 Hydrology	2	C.E. 87a Structural Design	4
Approved Elective	2	F.M. 4 Farm Buildings	3
		E.E. 2 Elementary Elect. Eng.	3
		Approved Elective	2
	10		17

Courses given by the Department of General Engineering Drawing, 1933-34.- As stated elsewhere, the Department of General Engineering Drawing offered courses in drawing and descriptive geometry from the beginning of engineering instruction. A few advanced courses added later brought the total number up to the seven shown as

follows in the 1933-34 issue of the Annual Register, the titles of which are more or less self-explanatory:

G.E.D.	1, Elements of Drawing,	4
	2, Descriptive Geometry	4
	4, Advanced drawing	4
	6, Elements of Drawing, for students in Chemical Engineering	3
	7, Architectural Projections	2
	8, Ditto	2
	10, Pictorial Drawing	3 or 4

In the first semester of 1937-38, a new course, G. E.D. 12, Graphical Calculations, was introduced for one hour credit. The work was given by Professor J.N. Arnold, exchange instructor form Purdue for the year, with Stanley Hall and Stanley Pierce teaching sections during the second semester, in addition to Professor Arnold. The course, still given in 1945 deals with the construction and use of nomographic charts; coordinate papers, including logarithmetic and semi-logarithmetic; various types of slide rules; and mechanical calculating devices; and other methods of engineering calculations.

An additional one-hour course was offered the second semester by Professor Arnold as a continuation of the first semester's work. This was G.E.D. 13, but was not repeated. All of the seven courses given in 1933-34, are still being taught in 1945.[1]

<u>Metallurgical Engineering.-</u> Upon the recommendation of Professor Stoek, an Option in Metallurgical Engineering as a part of the Curriculum in Mining Engineering was first offered in the fall of 1916. The metallurgical option was elective in the senior year and consisted of courses in process metallurgy, mineral dressing, and metallurgical design. The courses in process metallurgy were taught in the Department of Chemistry by Professor D.F. McFarland. This option in metallurgy with certain variations in course requirements, was continued until 1934, when because of the growing need for men having basic engineering training in this important field a new curriculum in Metallurgical Engineering was adopted.,- the 1933-34 number of the Register carrying the first announcement of such a change. After

1. A new course G.E.D. 3, Aircraft Drafting and Lofting, 2 hours credit, was made available in November, 1944, for students in Aeronautical Engineering.

the establishment of this curriculum, all courses in metallurgy were taught within the Department. The first degree in Metallurgical Engineering was granted in the spring of 1935.

First Curriculum in Metallurgical Engineering.-The first curriculum in Metallurgical Engineering, listed in the 1933-34 issue of the Annual Register, as previously stated, contained the following arrangement of courses:

FIRST YEAR

FIRST SEMESTER	Hours	SECOND SEMESTER	Hours
Chem.2 or 3-Organic Chemistry	3 or 4	Chem. 4 - Metallic Elements	4
G.E.D. 1 or 4-Elements of Draft.	4	G.E.D. 2-Descriptive Geometry	4
Math.2-Advanced Algebra	3	Math. 6a-Analytic Geometry	4
Math.4 or 5-Trigonometry	2	Rhet. 2-Rhetoric and Composition	3
Rhet. 1-Rhetoric and Composition	3	Physical Education	1/2
Physical Education	1/2	Hygiene	2
Military Drill and Theory	1	Military Drill and Theory	1
Engineering Lecture	0	Engineering Lecture	0
Total 16½ or	17½	Total	18½

SECOND YEAR

Chem.22-Quantitative Analysis	5	Math. 8b - Integral Calculus	3
Geol. 20 - Mineralogy	3	Met. 2 - Principles of Metallurgy	2
Math. 8a-Differential Calculus	3	M.E.85-Pattern and Foundry Lab.	3
Phys. 1a-General Physics	3	Phys. 1b - General Physics	3
Phys. 3a - Physics Laboratory	2	Phys. 3b - Physics Laboratory	2
Physical Education	1/2	T.&A.M. 1 - Analytical Mechanics	2
Military Drill and Theory	1	Approved Elective	2
		Physical Education	1/2
		Military Drill and Theory	1
	17½		18½

THIRD YEAR

Cer. 21 - Pyrometry	1	Cer. 20 - Refractories	2
Chem. 40 - Physical Chemistry	3	Met. 5 - Ferrous Metallurgy	3
Met. 3 - Assaying	2	Met. 6 - Metallurgical Calculations	2
Met. 4 - Physical Metallurgy	3	M.E.62-Mech.Engineering Laboratory	3
Min. 13 - Utilization of Fuels	3	Min. 10-Electrical Engineering	3
T. & A.M. 2 - Analytical Mechanics	3	T.&A.M. 3-Resistance of Materials	3
Approved Elective	3	T.&A.M. 63-Resistance of Mat'ls. Lab.	1
	18		17

FOURTH YEAR

Met. 7 - Metallography	2	Met. 10 - Advanced Metallography	4
Met. 8 - Non-ferrous Metallurgy	3	Met. 11 - Electrometallurgy	3
Met. 9-Physical-Chemical Treatment	3	Met. 42-Metallurgical Design	2
Met. 41-Metallurgical Design	3	Min.64-Coal and Ore Preparation Lab.	3
Met. 99 - Inspection Trip	0	Min. 90 - Seminar	1
Min. 8 - Mine Administration	3	T.&A.M. 4 - Hydraulics	2

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Min. 9 - Coal and Ore Preparation	3	Approved Elective	3
	17		18

Administrative Option in Ceramic Engineering.--In 1934-35 an administrative option was offered in Ceramic Engineering for students who were interested especially in the administrative phases of that field. The work during the first two years was the same as the regular curriculum, but varied from it somewhat during the last two years for students desiring to secure training for commercial or administrative positions. The arrangement of courses was as follows:

THIRD YEAR

FIRST SEMESTER	Hours	SECOND SEMESTER	Hours
Cer. 5 - Ceramic Bodies	5	Cer. 11 - Drying Clay products	3
Cer.7-Structural Clay Products	3	Cer. 14 - Glasses and Glazes	3
T.&A.M. 2-Analytical Mechanics	3	T.A.M. 3 - Resistance of Materials	3
Econ.2 - Elements of Economics	3	T.A.M.63-Resistance of Materials Lab	1
B.O.O.1-Ind. Organ. and Management	3	B.O.O.2-Marketing Organ. & Operation	3
Rhet.10-Business Letter Writing	2	Econ.3-Money-Credit, and Banking	3
	19		16

FOURTH YEAR

Cer. 21 - Ceramic Pyrometry	1	Cer. 20 - Refractories	2
Cer. 22 - Kilns and Burning	3	Cer. 24 - Ceramic Engineering	3
Cer. 23 - Dryer and Kiln Design	2	Cer. 28 - Pyrochemical Problems	2
C.E.89-Structural Engineering	3	Bus.Law 3-Law for Engrg. Students	3
B.O.O. 7 - Salesmanship or	2	Econ.43-Personnel Administration or	3
Accy.12-Fundamental Accounting	3	Accy.2a-Elements of Cost Accounting	3
B.O.O.4-Management in Manufacturing or	3	Econ.10-Corporate Man. and Finance or	3
Eng. 39-Industrial Relations	3	B.O.O.22-Marketing Policies and Probl.	3
Elective	3-4	Elective	2
	18		18

New Courses in Electrical Engineering.-Four new courses in electrical engineering for students in Mining and Ceramic Engineering were approved for classes in 1935-36. These were E. E. 4, Direct and Alternating Current Circuits and Machines, 2 hours credit; E. E. 64, Direct and Alternating Current Circuits and Machine Laboratory, 1 hour; E. E. 5, Applications of Electrical Equipment, 2 hours; and E. E. 65, Electrical Equipment Laboratory, 1 hour.

Three additional courses were adopted in 1936-37 for students in electrical engineering: E. E. 57, Electrical Energy Measurements and System Protection, 3

hours; E. E. 59, Electron Tubes, 3 hours; and E. E. 89, Electron Tube Laboratory, 1 hour.

These new courses were introduced for the purpose of giving the instruction to students in other departments formerly given within those departments, and of keeping their own students abreast of the developments in the field of electronics and power production and distribution.

Petroleum Engineering.-A new option in Petroleum Engineering involving studies in Engineering and geology was established in 1934-35 by Professor W. V. Howard of the Department of Geology and Geography in the College of Liberal Arts and Sciences. The basic work of the curriculum was much the same as that for the curriculum in mechanical engineering.

Two new courses in Petroleum Production Engineering were developed by Mr. R. F. Larson, Associate in Mechanical Engineering, and were offered for the first time in 1935-36. These were: M. E. 35, Petroleum Production Engineering, 3 hours credit, first semester, which includes such topics as properties of petroleum, exploration methods, development, drilling, hydrology, and finishing the well; and M. E. 36, Petroleum Production Engineering, 3 hours credit, second semester, which includes reservoir drainage, controlled flowing, gas lift, pumping, repressuring, water drive, natural gasoline, storage, and transportation.

Both courses appear in the fourth year of the option and deal, as indicated above, with the engineering problems encountered in the petroleum and natural-gas producing industry.

b. ENGINEERING COURSES

General.- In order to offer a broader basic training for students in engineering so as to prepare them to deal intelligently with the social as well as the technical aspects of the work of their chosen profession, a number of courses, called engineering courses, have been approved by the College faculty from time to time. These have been made available in the Announcement of Courses as approved or non-technical electives in all engineering curricula and have been popular electives for most of the departments within the College. These are described briefly in

the next few paragraphs.

Eng. 39, Industrial Relations.-Industrial Relations, a three-hour course offered both semesters with junior standing as prerequisite, was first given in the fall of 1933 as M. E. 39. Since that time it has been called Eng. 39. The course gives consideration to the following subjects: History of the development of industry; the factory system; manufacturers' organizations; labor organizations;works management; wage systems; personnel problems; labor legislation. The course has been administered by Professor Casberg.

Eng. 10, Engineering Economics.-Engineering Economics, a three-hour course offered both semesters, at first with junior standing, but later with sophomore standing, as prerequisite, was first given in February, 1934. The course takes up the subjects usually considered in discussions of the elementary principles of economic theory with applications, however, to different phases of engineering practice. The course was given by E. E. King until March, 1941, and by E. G. Young after that date.

Eng. 92, Engineering Law.-Engineering Law, a three-hour course offered both semesters with senior standing in engineering or architecture as prerequisite, was first given in February, 1934. The course gives consideration to the following materials: Contracts, evidence, torts, equity, real property, corporations, agency, sales, negotiable instruments, water rights, patent rights, special assessments, contract letting, general conditions. The course has been given by J. C. Crandall, G. W. Pickels, and L. L. Smith.

Eng. 20, History of Engineering.-History of Engineering, a two-hour course offered both semesters with junior standing as prerequisite, began in the fall of 1939. The subject matter includes the following: important elements in the growth in the art and science of engineering from ancient times to the present; lives of some of the men who have been leaders in engineering; effect of engineering on social conditions of various periods. The course has been given by J. O. Draffin.

Eng. 40, Transportation Development.-Transportation Development, a two-hour course offered both semesters, with sophomore standing as prerequisite, was first offered

in the fall of 1940. The subjects discussed in the course include the following: Transportation systems; history and technical development of city transit systems, and of rail, highway, waterway, and air transport; organization and interrelation. The course has been given by J. C. Crandall and E. G. Young.

Eng. 30, Secondary Civilian Pilot Ground Course.-The Secondary Civilian Pilot Ground Course, a three-hour course with junior standing and enrollment in the Controlled Restricted Commercial Course in the Civilian Pilot Training Program, previously mentioned as prerequisite, was listed in the 1941-42 Register, and was given by H. J. Reich and G. H. Dell.

Eng. 41, Transportation Problems.- Transportation Problems, a three-hour course offered both semesters, with Eng. 40 or senior standing as prerequisite, was first offered also in the fall of 1940. The course gives consideration to the following topics: Regulation of transportation systems, technical, operating, and financial, by government bodies; government vs. private ownership and operation; technical and economic problems of transport systems. This course has also been administered by J. C. Crandall and E. G. Young.

Eng. 29, Primary Civilian Pilot Ground Course.-The Primary Civilian Pilot Ground Course, a three-hour course with sophomore standing and enrollment in the Controlled Civilian Private/Training Program as prerequisite, was offered in the second semester of 1941-42, by H. J. Reich and G. H. Dell.

C. RAILWAY CURRICULA ABANDONED

General.- When Professor Schmidt retired from active direction of the Department of Railway Engineering in 1940, the department was abandoned, as discussed at some length in a previous chapter of this publication. At that time the registration of students was not sufficient to justify the maintenance of a separate department and there was little prospect of immediate improvement. The railroads were somewhat at a standstill and were not adding very great numbers of trained personnel to their technical departments. Therefore, American students were not particularly

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attracted to the industry. Furthermore, war, trade, currency, and other untoward conditions prevented the usual run of foreign students from coming to the University. Under this combination of circumstances, there seemed little to do but to disband.

Curriculum in Railway Civil Engineering, 1939-40.- The following curriculum in Railway Civil Engineering was offered when the Department was discontinued in 1940:

FIRST YEAR
Same as the general program for freshmen in 1941-42.

SECOND YEAR

FIRST SEMESTER		SECOND SEMESTER	
C.E.1-Plane Surveying	3	C.E.2-Topographic Surveying	3
Math.7 - Differential Calculus	5	C.E. 35 - Plain Concrete	2
Phys. 1a - General Physics	4	Math. 9 - Integral Calculus	3
Phys. 3a-Physics Laboratory	1	Phys. 1b-General Physics	4
R.E. 25 - Railway Development	2	Phys. 3b-Physics Laboratory	1
Non-technical Elective	2	T.A.M.1 -Analytical Mechanics(Statics_	2
Physical Education	1/2	Non-Technical Elective	2
Military Science (for men)	1	Physical Education	1/2
		Military Science (for Men)	1
	18½		18½

THIRD YEAR

C.E. 61 - Structural Stresses	4	C.E. 3 - Ry. and Hy. Surveying	4
Language or Approved Elective	4	C.E. 62-Structural Design	3
R.E.32-Railway Construction	3	C.E. 63-Theory of Reinf. Concrete	2
T.A.M. 2-Anal. Mech. (Dynamics)	3	Language or Approved Elective	4
T.A.M.3-Resistance of Materials	3	R.E. 36-Railway Maintenance	3
T.AM.63-Res. of Mat. Laboratory	1	R.E. 51 - Seminar	1
	18		17

FOURTH YEAR

C.E. 64-Structural Design	5	C.E. 65 - Structural Design	4
C.E. 90-Contracts & Specifications	2	C.E.66-Masonry Construction	3
M.E.1-Steam, Air, and Gas Machinery	3	E.E.4 and 64-D.C. and A.C. Circuits and Machines, with Lab. or Approved Elective	3
R.E.31-Railway Yards and Terminals	3	R.E. 33 - Railway Location	4
R.E.35-Railway Signaling	2	R.E. 37 - Railway Design Problems	2
R.E.99-Inspection Trip	0		
T.A.M. 4 - Hydraulics	2		
T.A.M. 64 - Hydraulics Lab.	1		
	18		16

Curriculum in Railway Electrical Engineering, 1939-40--The following curriculum in Railway Electrical Engineering was being offered when the Department was discontinued in 1940:

FIRST YEAR
Same as general program for freshmen in 1941-42.

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SECOND YEAR

FIRST SEMESTER		SECOND SEMESTER	
Language or Approved Elective	4	Language or Approved Elective	4
Math. 7-Differential Calculus	5	Math. 9 - Integral Calculus	3
Phys. 1a-General Physics	4	M.E.85-Pattern and Foundry Lab.	3
Phys. 3a-Physics Laboratory	1	Physics 1b-General Physics	4
R.E. 25-Railway Development	2	Physics 3b-Physics Laboratory	1
Physical Education	1/2	T.A.M. 1-Analytical Mech.(Statics)	2
Military Science (for men)	1	Physical Education	1/2
		Military Science (for men)	1
	17½		18½

THIRD YEAR

E.E. 25-Introduction to Circuit Analysis	4	E.E.26-Direct Current Apparatus	3
E.E.75-Electrical Eng. Lab.	2	E.E.76-Electrical Eng. Laboratory	3
M.E.87-Machine Tool Laboratory	3	M.E.10-Thermodynamics	3
Phys.44a-Electrical and Magnetic Measurements	3	R.E.60-Electric Railway Principles	2
R.E.59-Electric Railway Principles	2	T.A.M.3-Resistance of Materials	3
T.A.M.2-Analytical Mech.(Dynamics)	3	T.A.M.63-Resistance of Mat.Laboratory	1
		Approved Elective	3
	17		18

FOURTH YEAR

E.E.35-A.C.Apparatus	4	C.E.90-Contracts and Specifications	2
E.E.85-Electrical Eng. Laboratory	2	E.E.36-A.C.Apparatus	4
M.E. 3-Steam Engineering	3	E.E.86-Electrical Eng. Laboratory	2
M.E.61-Mech. Engineering Lab.	2	R.E.67 - Seminar	1
R.E.35-Railway Signaling	2	R.E.70-Electric Railway Design	2
R.E.62-Electric Railway Lab.	2	R.E.74-Electric Railway Economics	3
R.E.64-Electric Railway Practice	3	Non-technical Elective	3
R.E.99-Inspection Trip	0		
	18		17

<u>Curriculum in Railway Mechanical Engineering, 1939-40</u>.-The following curriculum in Railway Mechanical Engineering was being given when the Department was discontinued in 1940.

FIRST YEAR

Same as common program for freshman in 1941-42.

SECOND YEAR

Same as Railway Electrical Engineering

THIRD YEAR

FIRST SEMESTER		SECOND SEMESTER	
M.E. 13-Thermodynamics	3	M.E. 6-Power Plant Equipment	4
M.E.87-Machine Tool Laboratory	3	M.E. 14-Thermodynamics	3
R.E.3-Locomotives	2	M.E.40-Mech. Engineering Design	3
T.A.M.2-Analytical Mech. (Dynamics)	3	M.E.64-Mech.Engineering Laboratory	3

T.A.M. 3-Resistance of Materials	3	M.E.88-Machine Tool Laboratory	3
T.A.M. 63-Res. of Materials Lab.	1	R.E.4 -Locomotives	3
Approved Elective	3		
	18		19

FOURTH YEAR

E.E. 11-D.C. and A.C. Circuits	3	C.E. 90-Contracts and Specifications	2
E.E. 61-D.C. and A.C. Laboratory	1	E.E. 12-D.C. and A.C. Apparatus	3
M.E. 89-Heat Treatment of Metals	3	E.E. 62-D.C. and A.C. Laboratory	1
R.E. 2 -Locomotive Design	3	R.E. 7 -Locomotive and Car Design	3
R.E. 5 -Railway Laboratory	3	R.E. 8- Railway Laboratory	2
R.E. 9 -Seminar	1	R.E. 61-Electric Traction	3
R.E. 99-Inspection Trip	0	Non-technical Elective	3
Non-technical Elective	3		
	17		17

d. ENGINEERING COLLEGE COURSES AND CURRICULA IN 1941-42

General.- The ten curricula given by the College of Engineering in 1941-42, are outlined in the next several pages, and represent a conservative balance or compromise in subjects and materials between what the available time allowances permit and what the demands of industry exact. The burden of differentiating between what to include in the curriculum and what to omit has grown more imposing with the years, for the requirements made on the profession have become more compelling as conditions in society have become more complex and involved. The one subject about which there has been little doubt, however, of the importance of its place in the curriculum, is mathematics. It is recognized to be even more requisite now than it was in the earlier days in building the instructional program, for more and more are the classroom materials for both elementray and advanced courses based upon the principles of mathematics,- in many cases especially in the advanced courses, the applications being somewhat complicated and compounded.

Common Program for Freshmen.- Practically all freshmen in the College of Engineering take a common foundational course of study, which is devoted primarily to such subjects as chemistry, drawing, mathematics, and rhetoric. The main reason for this arrangement is that it enables the student to make a more intelligent choice of an instructional program after he has had some college training and has learned something of his own aptitudes for the different lines or work and has had an opportunity to meet other students who are enrolled in the several curricula and to learn from

them and the faculty and his own observations what each field represents in professional service. Unless otherwise specified, the following arrangement of subjects was prescribed for all curricula given by the College during 1941-42. This particular schedule is chosen as representative of recent years, for those coming later were made somewhat irregular to accommodate programs designed for war-time conditions.

FIRST SEMESTER		HOURS	SECOND SEMESTER		HOURS
Chem. 2 or 3 --	Inorganic Chemistry	3 or 4	Chem. 4 --	Metallic Elements	4
G.E.D. 1 or 4 -	Elements of Drawing	4	G.E.D. 2 -	Descriptive Geometry	4
Math. 2 --	Advanced Algebra	3	Math. 6a	Analytic Geometry	4
Math. 4 or 5	Trigonometry	2	Rhet. 2	Rhetoric and Composition	3
Rhet. 1	Rhetoric and Compos.	3	Hygiene		2
Physical Education		$\frac{1}{2}$	Physical Education		$\frac{1}{2}$
Military Science (for Men)		1	Military Science (for Men)		1
Engineering Lecture		0	Engineering lecture		0
	Total	$16\frac{1}{2}$ or $17\frac{1}{2}$			$18\frac{1}{2}$

Agricultural Engineering.- The curriculum in Agricultural Engineering with an option in machinery and power, and another option in construction and drainage, includes fundamental courses in the College of Engineering and in the College of Agriculture in the attempt to apply the principles of Engineering to the solution of problems in agriculture. The curriculum taken from the 1941-42 Annual Register showed the following arrangement of courses:

CURRICULUM IN AGRICULTURAL ENGINEERING

For the Degree of Bachelor of Science in Agricultural Engineering

FIRST YEAR

Common Program for Freshmen (See above), except that Chem. 5 is substituted for Chem. 4.

SECOND YEAR

FIRST SEMESTER	HOURS	SECOND SEMESTER	HOURS
Agr. E. 2 Field and Power-Driven Machinery	3	Agr.E. 3 Gas Engines and Tractors	3
Bot. 5 Botany	3	Agronomy 25 Farm Crops	4
Math. 7 Differential Calculus	5	Math. 9 Integral Calculus	3
Phys. 1a General Physics	4	Phys. 1b General Physics	4
Phys. 3a Physics Laboratory	1	Phys. 3b Physics Laboratory	1
Physical Education	$\frac{1}{2}$	T.A.M. 1 Analyt. Mech. (Statics)	2
Military Science (for Men)	1	Physical Education	$\frac{1}{2}$
		Military Science (for Men)	1
Total	$17\frac{1}{2}$		$18\frac{1}{2}$

THIRD YEAR

MACHINERY AND POWER OPTION

Econ. 2	Elements of Economics	3	Agr. Econ. 20	Farm Management	3
Geol. 44	Agricultural Geology	3	Agronomy 28	Soils	5
M. E. 31	Mechanics of Machinery	5	M.E. 10	Thermodynamics	3
T.A.M. 2	Analyt. Mech. (Dynamics)	3	M.E. 40	Mech. Eng. Design	3
T.A.M. 3	Resistance of Materials	3	M.E. 85	Pattern and Foundry Lab.	3
T.A.M. 63	Res. of Materials Lab.	1			
	Total	18		Total	17

CONSTRUCTION AND DRAINAGE OPTION

C.E. 15	General Surveying	3	Agr. Econ. 20	Farm Management	3
C.E. 35	Plain Concrete	2	Agr. E. 12	Farm Utilities	3
Econ. 2	Elements of Economics	3	Agronomy 28	Soils	5
Geol. 44	Agricultural Geology	3	C.E. 61	Structural Stresses	4
T.A.M. 2	Analyt. Mech. (Dynamics)	3	T.A.M. 4	Hydraulics	2
T.A.M. 3	Resistance of Materials	3	T.A.M. 64	Hydraulics Lab.	1
T.A.M. 63	Res. of Materials Lab.	1			
	Total	18		Total	18

FOURTH YEAR

MACHINERY AND POWER OPTIONS

Agr. E. 43	Farm Power	3	Agr. E. 44	Design of Agricultural Machinery	3
Agr. E. 99	Inspection Trip	0	Agr. E. 51	Special Problems	3
E.E. 11	D.C. and A.C. Circuits	3	E.E. 12	D.C. and A.C. Apparatus	3
E.E. 61	D.C. and A.C. Laboratory	1	E.E. 62	D.C. and A.C. Laboratory	1
M.E. 41	Mech. Eng. Design	4	M.E. 89	Heat Treatment of Metals	3
M.E. 87	Machine Tool Lab.	3	Approved Elective		4
Approved Elective		3			
	Total	17		Total	17

CONSTRUCTION AND DRAINAGE OPTION

Agr. E. 42	Hydraulics of Soil and Water Conservation	3	Agr. E. 51	Special Problems	3
Agr. E. 45	Advanced Farm Struct.	3	C.E. 51	Drainage and Flood Control	3
Agr. E. 99	Inspection Trip	0	C. E. 87	Steel, Concrete, and Timber Design	4
C.E. 50	Hydrology	2	C.E. 90	Contracts and Specifications	2
C.E. 86	Steel, Concrete, And Timber Design	4	Approved Elective		4
E.E. 4	D.C. and A.C. Circuits and Machines	2			
E.E. 64	D.C. and A.C. Circuits and Machines Laboratory	1			
Approved Elective		2			
	Total	17		Total	16

Ceramic Engineering.- The curriculum in Ceramic Engineering uses the common program for freshmen except for a few modifications in chemistry and mathematics. To the basic principles underlying all engineering science that are included in the

first two years' work in this curriculum, are added the elements of technology involved in the production of structural-clay products, glasses, glazes, and vitreous enamels. An administrative option is provided for students interested in the commercial or administrative phases of the ceramic industries. The curriculum as offered in 1941-42 appears below.

CURRICULUM IN CERAMIC ENGINEERING

For the Degree of Bachelor of Science in Ceramic Engineering

FIRST YEAR

Common Program for Freshmen except that Chem. 6 and Math. 10a-10b are substituted for Chem. 4 and Math. 2, 4, 6a.

SECOND YEAR

FIRST SEMESTER	HOURS	SECOND SEMESTER	HOURS
Cer. E. 1 Ceramic Materials	3	Cer. E. 4 Ceramic Materials Lab.	3
Chem. 10 Qualitative Analysis	5	Chem. 23b Quantitative Analysis	4
Math. 8a Differential Calculus	3	Math. 8b Integral Calculus	3
Phys. 1a General Physics	4	Phys. 1b General Physics	4
Phys. 3a Physics Laboratory	1	Phys 3b Physics Laboratory	1
Physical Education	½	T.A.M. 1 Analytical Mech. (Statics)	2
Military Science (for Men)	1	Physical Education	½
		Military Science (for Men)	1
Total	17½	Total	18½

THIRD YEAR

Cer. E. 5 Ceramic Bodies	5	Cer. E. 11. Drying Clay Products	3
Cer. E. 7 Structural Clay Products	3	Cer. E. 24 Glasses and Glazes	3
Geol. 43 Engineering Geology or Geol. 20 General Mineralogy	3	Cer. E. 21 Ceramic Pyrometry	1
T.A.M. 2 Analyt. Mech. (Dynamics)	3	Chem. 40 Physical Chemistry	3
T.A.M. 3 Resistance of Materials	3	C.E. 15 General Surveying	3
T.A.M. 63 Resistance of Materials Laboratory	1	M.E. 62 Mech. Engineering Lab.	3
		Approved Elective	2
Total	18	Total	18

ADMINISTRATION OPTION

B.O.O. 1 Industrial Organization and Management	3	B.O.O. 2 Marketing Organization and Operation	3
Cer. E. 5 Ceramic Bodies	5	Cer. E. 11 Drying Clay Products	3
Cer. E. 7 Structural Clay Products	3	Cer. E. 14 Glasses and Glazes	3
Econ. 2 Elements of Economics	3	Econ. 3 Money, Credit, and Banking	3
T.A.M. 3 Resistance of Materials	3	Rhet. 10 Business Letter Writing	2
T.A.M. 63 Resistance of Materials Laboratory	1	Approved Elective	3
Total	18	Total	17

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FOURTH YEAR

Cer. E. 22 Kilns and Burning	3	Cer. E. 20 Refractories	2
Cer. E. 23 Dryer and Kiln Design	2	Cer. E. 24 Ceramic Eng. Design	3
Cer. E. 99 Inspection Trip	0	Cer. E. 28 Pyrochemical Problems	2
C.E. 89 Structural Engineering	3	E.E. 5 Applications of Electrical Equipment	2
E.E. 4 D.C. and A.C. Circuits and Machines	2	E.E. 65 Electrical Equipment Laboratory	1
E.E. 64 D. C. and A.C. Circuits and Machines Laboratory	1	Approved Elective	3
Approved Elective	3	Technical Option	3
Technical Option	3		
Total	17	Total	16

ADMINISTRATION OPTION

		Eng. 39 Industrial Relations	3
Cer. E. 21 Ceramic Pyrometry	1	Cer. E. 20 Refractories	2
Cer. E. 22 Kilns and Burning	3	Cer. E. 24 Ceramic Eng. Design	3
Cer. E. 23 Dryer and Kiln Design	2	Cer. E. 28 Pyrochemical Problems	2
C. E. 89 Structural Engineering	3	B.O.O. 7 Salesmanship	2
Accy. 12 Fundamentals of Accounting; or Econ. 70 Elements of Statistics	3	Eng. 92 Engineering Law; Or Bus. Law 2 Elementary Law of Business	3
Econ. 35 Corporation Finance	3	Approved Elective	2
Approved Elective	2		
Total	17	Total	17

Ceramics.- The curriculum in Ceramics prescribes definite language requirements in the freshman year and some changes in courses in chemistry and mathematics from those found in the common freshman programs in the College of Engineering. Courses of chemistry follow during the next three years. In addition to prescribed courses pertaining to the production of glasses, glazes, and enamels, some attention is given to metallurgical and mineralogy problems. The curriculum as administered in 1941-42 appears below.

CURRICULUM IN CERAMICS

for the Degree of Bachelor of Science in Ceramics

A FIRST YEAR

FIRST SEMESTER	HOURS	SECOND SEMESTER	HOURS
~~Hygiene~~	~~2~~	Hygiene	2
Chem. 2 or 3 Inorganic Chemistry	3 or 4	Chem. 6 Inorganic Chemistry	5
Math 10a First Year College Math.	5	Math. 10b First Year College Math	4
German or French	4	German or French	4
Rhet. 1 Rhetoric and Composition	3	Rhet 2 Rhetoric and Composition	3
Physical Education	½	Physical Education	½
Military Science (for Men)	1	Military Science (for Men)	1
Engineering Lecture	0	Engineering Lecture	0
Total	16½ or 17½	Total	19½

SECOND YEAR

Cer. E. 1 - Ceramic Materials	3	Cer. E.4-Ceramic Materials Lab.	3
Chem. 10-Qualitative Analysis	5	Chem. 23b-Quantitative Analysis	4
Math. 8a-Differential Calculus	3	Math. 8b-Integral Calculus	3
Phys. 1a - General Physics	4	Phys. 1b - General Physics	4
Phys. 3a-Physics Laboratory	1	Phys. 3b-Physics Laboratory	1
Physical Education	½	Physical Education	½
Military Science (for men)	1	Military Science (for men)	1
		Approved Elective	2
	17½		18½

THIRD YEAR

Cer. E. 5 - Ceramic Bodies	5	Cer. E. 11-Drying Clay Products	3
Cer. E.7-Structural Clay Products	3	Cer. E. 14-Glasses and Glazes	3
Cer. E. 21 - Ceramic Pyrometry	1	Chem. 40 - Physical Chemistry	3
Met. 1 - Elements of Metallurgy	3	Chem. 41 -Physical Chemistry Lab.	1
Geol. 20 - General Mineralogy	3	Geol. 6-Optical Mineralogy	3
Phys. 16 - Heat	3	Approved Elective	3
	18		16

FOURTH YEAR

Cer. E. 22 - Kilns and Burning	3	Cer. E. 20- Refractories	2
Cer. E. 97-Thesis	3	Cer. E. 28 - Pyrochemical Problems	2
Cer. E. 99 - Inspection Trip	0	Cer. E. 98 - Thesis	3
E.E. 4-D.C. and A.C. Circuits and Machines	2	Chem. 33 - Organic Chemistry	5
E.E.64-D.C. and A.C. Circuits and Machines Laboratory	1	Technical Option	5
Approved Elective	3		
Technical Option	6		
Total	18	Total	17

Civil Engineering.-In this civil engineering curriculum as in all previous ones, the first year is devoted primarily to the foundational subjects as mentioned in a previous paragraph. The sophomore year continues with mathematics and takes up physics a d mechanics along with surveying in preparation for the more advanced courses dealing with route surveying and highway construction, the examination of structural materials and the analysis of structural stresses, in addition to studies in the operation of mechanical and electrical machinery, that come in the junior year. All of this preliminary preparation is designed to lead the way to the more specialized and professional work of the senior year in which the student takes up advanced subjects in sanitary engineering and structural analysis along with the courses which come within the particular option he has chosen to follow,-whether it be the general, highway, hydraulic, sanitary, structural, or railway

option,-the work in railway engineering having been transferred to the Department when the Department of Railway Engineering was abolished in September, 1940. The curriculum including options as administered in 1941-42 was as follows:

Curriculum in Civil Engineering

For the Degree of Bachelor of Science in Civil Engineering

FIRST YEAR

Common Program for Freshmen

SECOND YEAR

FIRST SEMESTER	Hours	SECOND SEMESTER	Hours
C.E. 1 - Plane Surveying	3	C.E. 2-Topographic Surveying	3
C.E.60-Bridge and Bldg. Constr.	3	Geol.43-Engineering Geology	3
Math. 7 - Differential Calculus	5	Math. 9 - Integral Calculus	3
Phys. 1a - General Physics	4	Phys. 1b-General Physics	4
Phys. 3a - Physics Laboratory	1	Phys. 3b - Physics Laboratory	1
Physical Education	$\frac{1}{2}$	T.A.M. 1-Analytical Mech.(Statics)	2
Military Science (for men)	1	Physical Education	$\frac{1}{2}$
		Military Science (for men)	1
	$17\frac{1}{2}$		$17\frac{1}{2}$

NOTE: Special third and fourth year curricula are available so that transfer students who have credit in all of the subjects included in the first and second year curricula except C.E. 1,2,60 and T.A.M. 1 can complete the requirements for the bachelor's degree in two years if they present an equivalent amount of credit.

THIRD YEAR

C.E.30-Highway Materials Lab.	1	C.E. 3-Route Surveying	4
C.E. 35 - Plane Concrete	2	C.E. 20 - Highway Construction	3
C.E. 36-Construction Materials	1	C.E. 62-Structural Design	3
C.E. 61 - Structural Stresses	4	C.E. 63 - Reinforced Concrete	2
M.E. 1-Steam,Air,and Gas Machinery	3	E.E.4--D.C. and A.C. Circuits and Machines	2
T.A.M. 2-Analyt. Mech.(Dynamics)	3	E.E. 64-D.C. and A.C. Circuits and Machines Laboratory	1
T.A.M. 3 - Resistance of Materials	3	or approved elective	3
T.A.M.63-Resistance of Materials Lab.	1	T.A.M. 4 - Hydraulics	2
		T.A.M. 64-Hydraulic Laboratory	1
Total	18	Total	18

FOURTH YEAR

All Options

FIRST SEMESTER		SECOND SEMSTER	
C.E. 40 - Water Supply	4	C.E. 41 - Sewerage	3
C.E. 64-Structural Design	5	C.E. 65-Structural Design	4
C.E. 99-Inspection Trip	0	Options (see below)	9 or 10

Options (see below)	9 or 10		
	18 or 19		16 or 17

GENERAL OPTION

C.E. 66-Earth and Masonry Structures	3	C.E.90-Contracts and Specifications	2
Technical Elective	3	Technical Elective	5
Non-technical elective	3	Approved Elective	3

HIGHWAY OPTION

C.E.22-Highway and Municipal Design	4	C.E.23-Highway Administration	3
C.E.50-Hydrology	2	C.E.31-Advanced Hy. Materials	2
Non-technical Elective	3	C.E.66-Earth and Masonry Structures	3
		C.E.90-Contracts and Specifications	2

HYDRAULIC OPTION

C.E.50 - Hydrology	2	C.E.51-Drainage and Flood Control	3
C.E.66-Earth and Masonry Structures	3	C.E. 55 - Water Power	3
C.E.90 - Contracts and Specifications	2	E.E.4-D.C. and A.C.Circuits and Machines	2
Non-technical Elective	3	E.E.64-D.C. and A.C. Circuits and Machines Laboratory	1

RAILWAY OPTION

C.E.25-Railway Construction and Maintenance	3	C.E. 26-Economics of Railway Location and Operation	3
C.E. 66-Earth and Masonry Structures	3	C.E. 27-Railway Yards and Terminals	2
Non-technical Elective	3	C.E.90-Contracts and Specifications	2
		Approved Elective	3

SANITARY OPTION

C.E. 42-Water Purification	4	C.E.43-Public Health Engineering	4
C.E.90-Contracts and Specifications	2	C.E.66-Earth and Masonry Structures	3
Bact.5a-Bacteriology	3	E.E.4-D.C. and A.C. Circuits and Machines	2
		E.E.64-D.C. and A.C. Circuits and Machines Laboratory	1

STRUCTURAL OPTION

C.E. 67-Statically Indet.Structures	3	C.E.66-Earth and Masonry Structures	3
C.E.90-Contracts and Specifications	2	C.E.68-Statically Indeterminate Structures	3
C.E. 91 - Estimates and Costs	2	Approved Elective	3
Non-technical Elective	3		

Option in Aeronautical Engineering.- In September, 1942, a new senior option in Civil Engineering was listed offering courses pertaining to the civil engineering phases of aeronautics, such as aerodynamics,the structural design of airplanes, airport design, and aerial navigation. The option is built on a strong basic

training in structural analysis and design including statically-indeterminate structures, and includes applications to the design of airplanes and hangars. It develops the principles of drainage and highway design and applies them to the drainage of airfields and the construction of runways. The Department of Electrical Engineering cooperates in providing instruction on airport illumination. The arrangement of courses in this option is as follows:

C.E. 10-Navigation	3	C.E. 24-Airport Design	2
C.E. 67-Statically Indet. Structures	3	C.E. 66-Earth and Masonry Structures	3
M.E. 33-Aeronautical Engineering	3	C.E.70-Airplane Structures	3
		C.E.90-Contracts and Specifications	2

Public-Health Engineering Curriculum in Civil Engineering.- Beginning in September, 1942, a five-year curriculum in Public-Health Engineering dealing with those phases of engineering that are distinctly related to public health, was added, at the urgent request of the State Department of Public Health, to the regular curriculum and options already offered in civil engineering in order to provide more comprehensive training for positions with federal, state, or municipal governments. The studies of the first three years are the same as those required of all students in the Department of Civil Engineering. The fourth year becomes the Sanitary Engineering option, replacing the one previously announced. The fifth year represents additional work in the field of public-health engineering. During the first semester of the fifth year of study, the instruction is given on the campus in Urbana and consists mainly of biological and chemical sciences, with one course in public-health engineering, and several electives from which the student may choose. The latter portion of the fifth year of work is given mainly through courses in Chicago, administered by the Department of Bacteriology and Public Health of the College of Medicine, of the University of Illinois. In addition, practical experience is gained through part-time work in public-health engineering problems in the field.. The degree of Bachelor of Science in Public-Health Engineering will be given upon the completion of the fifth year of work.

This arrangement serves to synchronize more closely the educational work in sanitary engineering here and the state-wide program carried on by the Department of Public Health at Springfield.

Fourth and Fifth Years of the Optional Curriculum in Public-Health Engineering,-the Fourth year being the regular Sanitary Engineering Option in Civil Engineering.

FOURTH YEAR

FIRST SEMESTER		SECOND SEMESTER	
C.E. 40-Water Supply Engineering	4	C.E. 41 - Sewerage	3
C.E. 64-Structural Design	5	C.E. 44 -Water and Sewage Treatment	3
C.E. 99-Inspection Trip	0	C.E. 65-Structural Design	4
Bact. 5a-Bacteriology	3	C.E. 66-Earth and Masonry Structures	3
Chem. 22-Quantitative Analysis	5	Chem. 33 - Organic Chemistry	5
Total	17	Total	18

FIFTH YEAR

FIRST SEMESTER		SECOND SEMESTER	
Chem.86a-Chemistry of Water Treatment	3	P.H. 1-Bact.and Protozoology	6
C.E.45--Public Health Engineering	3	P.H.4-Preventive Medicine	2
Zool.51-Essentials of Zoology	4	C.E.140-Public Health Engineering	3
Chem. 47 - Physical Chemistry	4	P.H.12-Industrial Hygiene	1
Approved Elective	5	P.H. 50 - Public Health	1
Dairy Husb. 10-Dairy Bacteriology		P.H.73-Public Health	2
Entomology 2-Insects		Pharmacology 32-Toxicology, or	
Math. 22-Statistical Analysis		elective	3
M.E. 25-Heating and Ventilation			
Total	19	Total	18

Symposium on Soil Mechanics and Foundation Engineering.-A Symposium on Soil Mechanics and Foundation Engineering, given under the auspices of the Department of Civil Engineering, beginning on September 29, 1942, was held througout the entire school year of 1942-43. The work consisted of a series of lectures given in Room 205 Engineering Hall. The schedule included ten lectures on Soil Mechanics by Dr. Ralph B. Peck, Assistant Engineer in charge of the Soils Laboratory of the Chicago Subway, and twelve by Albert E. Cummings, Lecturer in Foundation Engineering of the Department of Civil Engineering, University of Illinois. Other Lecturers included other members of the staff in the Department of Civil Engineering and one or two members of the staff of the Illinois Geological Survey. The work was available for University credit to seniors and graduate students in Civil Engineering.

Electrical Engineering.-The courses in the first two years of the curriculum in Electrical Engineering, and which, in the main, are common to most of the curricula in engineering, deal with the elementary, yet fundamental principles underlying the

field of engineering science. They provide for instructional work in the principles of mathematics, physics, and chemistry, and for practice problems in the drafting room and shop. The only specialized course in the two years is one coming in the second year and deals with industrial wiring and illumination.

Courses in the last two years consider such phases of applied electricity as the generation, transmission, and distribution of electric power, and such additional subjects as electronics, radio, telephono, and other forms of communication, illumination, high-frequency circuits, and electric-railway transportation. The curriculum as administered in 1941-42 appears below.

CURRICULUM IN ELECTRICAL ENGINEERING

For the Degree of Bachelor of Science in Electrical Engineering

FIRST YEAR

Common Program for Freshmen (page 136).

SECOND YEAR

FIRST SEMESTER		SECOND SEMESTER	
E.E.14-Wiring and Illumination or Approved Elective	3 or 4	E.E.14-Wiring and Illumination or Approved Elective	3 or 4
Math. 7-Differential Calculus	5	Math.9-Integral Calculus	3
M.E.85 or 87-Pattern and Foundry or Machine Tool Laboratory or Approved Elective	3	M.E.87 or 85-Machine Tool or Pattern and Foundry Laboratory; or Approved Elective	3
Phys. 1a - General Physics	4	Phys. 1b-General Physics	4
Phys. 3a-Physics Laboratory	1	Phys. 3b-Physics Laboratory	1
Physical Education	½	T.A.M.1-Analytical Mech. (Statics)	2
Military Science (for men)	1	Physical Education	½
		Military Science (for men)	1
Total	17½ or 18½	Total	17½ or 18½

THIRD YEAR

E.E.25-Introduction to Circuit Analysis	4	E.E.26-Direct Current Apparatus	3
E.E.75-Electrical Engineering Lab.	2	E.E.76-Electrical Engineering Lab.	3
Math. 9a-Integral Calculus	2	E.E.50-Introduction to Applied Electronics	2
M.E.10-Thermodynamics; or Phys.44a-Electrical and Magnetic Measurements	3	M.E.10-Thermodynamics; or Phys.44a-Electrical and Magnetic Measurements	3
T.A.M.2-Analyt.Mech.(Dynamics)	3	T.A.M. 3-Resistance of Materials	3
T.A.M.4-Hydraulics	2	T.A.M. 63-Res. of Materials Lab.	1
T.A.M.64-Hydraulics Laboratory	1	Approved Elective	3
Total	17	Total	18

FOURTH YEAR

E.E. 35 A.C. Apparatus	4	E.E. 36 A.C. Apparatus	4
E.E. 55 Electrical Design	2	E.E. 56 Economics of Electrical Systems	4
E.E. 85 Electrical Engineering Lab.	2	E.E. 86 Electrical Engineering Lab.	2
E.E. 95 Seminar	1	E.E. 96 Seminar	1
E.E. 99 Inspection Trip	0	E.E. 98 Thesis or Technical Elective	3
M.E. 3 Power Plant Engineering	3	Approved Elective	3 or 4
M.E. 61 Mech. Engineering Lab.	2		
Non-technical Elective	3 or 4		
Total	17 or 18		17 or 18

General Engineering.- The cu$rriculum in General Engineering is prepared for those students who do not wish to undertake the more specialized engineering curricula, but who are anxious to secure a sound education in engineering principles and their application to scientific management and operation of enterprises. The curriculum is a combination of engineering and business business/courses, balanced to give training for positions that tend to lead toward administrative careers. The curriculum as given in 1941-42 was arranged as follows:

CURRICULUM IN GENERAL ENGINEERING
For the Degree of Bachelor of Science in General Engineering
(Common program for all freshmen)

SECOND YEAR

FIRST SEMESTER		SECOND SEMESTER	
Econ.2-Principles of Economics	3	Geol. 43-Engineering Geology	3
Math. 7-Differential Calculus	5	Math. 9-Integral Calculus	3
M.E.85-Pattern and Foundry Lab. or C.E. 15-General Surveying	3	C.E.15-General Surveying; orM.E. 85-Pattern and Foundry Lab	3
Phys. la-General Physics	4	Phys.1b-General Physics	4
Phys.3a-Physics Laboratory	1	Phys. 3b-Physics Laboratory	1
Physical Education	½	T.A.M. 1-Analytical Mech.(Statics)	2
Military Science (for men)	1	Physical Educatinn	½
		Military Science (for men)	1
Total	17½	Total	17½

THIRD YEAR

Econ.35-Corporations	3	C.E.61-Structural Stresses	4
E.E.11-D.C. and A.C. Circuits	3	E.E.12-D.C. and A.C. Apparatus	3
E.E.61-D.C. and A.C. Laboratory	1	E.E.62-D.C. and A.C. Laboratory	1
M.E.87-Machine Tool Laboratory	3	M.E.10-Thermodynamics	3
T.A.M.2-Analyt.Mech.(Dynamics)	3	T.A.M.4-Hydraulics	2
T.A.M.3-Resistance of Materials	3	T.A.M.64-Hydraulics Laboratory	1
T.A.M.63-Res. of Materials Lab.	1	Approved Elective	4
Total	17	Total	18

FOURTH YEAR

C.E.86-Structural Design	4	Eng. 92-Engineering Law	3
C.E. 99-Inspection Trip	0	C.E. 87 - Structural Design	4
Econ. 41-Labor Problems; or Eng. 39-Industrial Relations	3	Econ. 3-Money,Credit, Banking	3
M.E.3--Power Plant Engineering	3	M.E.64-Mechanical Engineering Lab.	3
Met. 1-Elements of Metallurgy	3	Approved Elective	5
Approved Elective	5		
Total	18	Total	18

Mechanical Engineering.-The curriculum in mechanical engineering presents an organized study of the theory and practice of the generation and transmission of power, and of the design, construction, operation, and testing of machinery of all kinds. Through a wide choice of electives, there is opportunity for an introduction to such subjects as economics, industrial organization, and business management. Technical options in the senior year enable the student to follow his interests in one of several fields, such as heat engineering, industrial administration, aeronautical engineering, refrigeration engineering, and heating, ventilating, and air-conditioning. There are curricular options also in petroleum-production engineering and in railway mechanical engineering,-the option in railway mechanical engineering having been added in September, 1940, when the Department of Railway Engineering was abolished. The curriculum in Mechanical Engineering in 1941-42 was as follows:

CURRICULUM IN MECHANICAL ENGINEERING
For the Degree of Bachelor of Science in Mechanical Engineering

FIRST YEAR
Common Program for Freshmen

SECOND YEAR

FIRST SEMESTER		SECOND SEMESTER	
Approved Elective	3	Approved Elective	4
Math.7-Differential Calculus	5	Math.9-Integral Calculus	3
M.E.85-Pattern and Foundry Lab.; or M.E. 87-Machine Tool Lab.	3	M.E.87-Machine Tool Lab.; orM.E. 85--Pattern and Foundry Lab.	3
Phys. 1a-General Physics	4	Phys. 1b-General Physics	4
Phys. 3a-Physics Laboratory	1	Phys. 3b-Physics Laboratory	1
Physical Education	$\frac{1}{2}$	T.A.M.1-Analytical Mech.(Statics)	2
Military Science (for men)	1	Physical Education	$\frac{1}{2}$
		Military Science (for men)	1
Total	$17\frac{1}{2}$	Total	$18\frac{1}{2}$

THIRD YEAR

M.E.13-Thermodynamics	3	M.E.6-Power Plant Equipment	4
M.E.31-Mechanics of Machinery	5	M.E.14-Thermodynamics	3
T.A.M.2-Analyt. Mech.(Dynamics)	3	M.E.40-Mech.Engineering Design	3
T.A.M.3-Resistance of Materials	3	M.E.64-Mech.Engineering Lab.	3
T.A.M63-Resistance of Materials Lab.	1	M.E.88-Machine Tool Laboratory	3
Non-technical Elective	3	Non-technical Elective	2
Total	18	Total	18

FOURTH YEAR

E.E.11-D.C. and A.C. Circuits	3	E.E.12-D.C. and A.C. Apparatus	3
E.E.61-D.C. and A.C. Laboratory	1	E.E.62-D.C. and A.C. Laboratory	1
M.E.41-Mech.Eng.Design	4	M.E.28-Heating,Ventilating, and Air Conditioning	4
M.E.65-Mech. Engineering Lab.	3	M.E.52-Power Plant Design	3
M.E.89-Heat Treatment of Metals; or Non-technical Elective	3	M.E. 89-Heat Treatment of Metals; or Non-technical Elective	3
Technical Option (See page 146)	3	Technical Option(See page 146)	3
M.E.99-Inspection Trip	0		
Total	17	Total	17

OPTIONS FOR THE CURRICULUM IN MECHANICAL ENGINEERING

Note: Curriculum options are groups of related courses which can be logically taken together and thus emphasize certain subdivisions, or fields, of mechanical engineering.

PETROLEUM PRODUCTION ENGINEERING

Substitute in Mechanical Engineering Curriculum as follows:

SECOND YEAR

FIRST SEMESTER		SECOND SEMESTER	
Geol. 43 for Approved Elective	3	Geol. 2a for Approved Elective	4

THIRD YEAR

C.E. 15 for Non-technical Elective	3	Non-technical Elective	2

FOURTH YEAR

M.E.35,T.A.M. 4 and 64, and Geol. 61a for M.E. 41 and Technical Option	9	M.E. 36,Geol. 60b, and Geol. 61b for M.E. 28 and 52 and Technical option	8

RAILWAY MECHANICAL ENGINEERING

Substitute in Mechanical Engineering Curriculum as follows:

FOURTH YEAR

M.E. 5 for Technical Option	3	M.E. 8 for Technical Option	3
		M.E. 54 for M.E. 52	3

TECHNICAL OPTIONS

FOURTH YEAR

FIRST SEMESTER		SECOND SEMESTER	
M.E. 5 - Locomotives	3	M.E. 7-Int. Combustion Engines	3
M.E. 7-Int. Combustion Engines	3	M.E. 8-Railway Operation	3

M.E.17-Refrigeration Engineering	3
M.E.33-Aeronautical Engineering	3
M.E.35-Petroleum Production Eng.	3
M.E.84-Welding Engineering	3
T.A.M. 4 and 64-Hydraulics	3
T.A.M. 41-Advanced Mechanics	3
T.A.M. 43-Hydraulics Laboratory	3
T.A.M. 44-Testing Materials	3
T.A.M. 47-Engineering Analysis	3
T.A.M. 49-Advanced Dynamics and Vibrations	3
C.E. 89-Structural Engineering	3

M.E.15-Engineering Thermodynamics	3
M.E.17-Refrigeration Engineering	3
M.E. 34-Aeronautical Engineering	3
M.E. 54-Locomotive and Car Design	3
M.E.36-Petroleum Production Eng.	3
M.E.84-Welding Engineering	3
T.A.M. 4 and 64 - Hydraulics	3
T.A.M. 42-Engineering Materials	3
T.A.M. 43-Hydraulics Laboratory	3
T.A.M. 44-Testing Materials	3
T.A.M. 48-Engineering Analysis	3
T.A.M. 50-Advanced Dynamics and Vibrations	3

Mining and Metallurgical Engineering.-The Department of Mining and Metallurgical Engineering here offers separate curricula as a basis for training men in the mining and metallurgical industries. Until recently the curriculum in Mining Engineering had four options: coal mining, ore mining, mining geology, and mine administration. To the preliminary courses in mathematics, physics, chemistry, general engineering drawing, and mechanics, common to all curricula in engineering, are added specialized courses in mine surveying, mining methods, prospecting, mine examinations, hoisting and haulage, mine ventilation, coal washing and ore dressing, mine administration, and the design of mining plants.

The curriculum in Metallurgical Engineering, still in effect, is planned to present the fundamentals of the science of modern metallurgy, maintaining a proper balance between the two main divisions,-process metallurgy and physical metallurgy. The training is intended to prepare the student for entrance after graduation, into either branch of the industry, and to afford those whose interests lie in advanced study and research, a broad foundation for the successful prosecution of graduate study in metallurgy. To such fundamental courses as are common to all engineering curricula, are added specialized courses in physical chemistry, principles of metallurgy, physical metallurgy, ferrous and non-ferrous metallurgy, metallography, electrometallurgy, and metallurgical design. Outlines of the two curricula as administered in 1941-42, follow:

CURRICULUM IN MINING ENGINEERING

For the Degree of Bachelor of Science in Mining Engineering

FIRST YEAR

Common Program for Freshmen (page 136), except that Chem. 5 and Math. 10a-10b are substituted for Chem. 4 and Math. 2, 4, 6a.

SECOND YEAR

FIRST SEMESTER		SECOND SEMESTER	
Chem.22-Quantitative Analysis	5	C.E. 15-General Surveying	3
Math. 8a-Differential Calculus	3	Geol. 43-Engineering Geology	3
Phys. 1a-General Physics	4	Math. 8b-Integral Calculus	3
Phys. 3a-Physics Laboratory	1	Phys. 1b-General Physics	4
Physical Education	½	Phys. 3b-Physics Laboratory	1
Military Science (for men)	1	T.A.M. 1-Analytical Mech.(Statics)	2
Approved Elective	3	Physical Education	½
		Military Science (for men)	1-
Total	17½	Total	17½

THIRD YEAR

		T. & A.M. 64-Hydraulics Lab.	4
Geol.20-Mineralogy	3	Min. 4-Mining Methods	4
Min. 1-Elements of Mining	4	T.A.M. 3-Resistance of Materials	3
Min. 62-Mine Surveying	3	T.A.M. 63-Res. of Materials Lab.	1
T.A.M.2-Analytical Mechanics(Dynamics)	3	T.A.M. 4- Hydraulics	2
Option (See page 148)	6	Option (See page 148)	5 or 7
	19		16 or 18

FOURTH YEAR

E.E.4-D.C. and A.C. Circuits and Machines	2	E.E.5-Applications of Electrical Equipment	2
E.E. 64-D.C. and A.C. Circuits and Machines Laboratory	1	E.E.65-Electrical Equipment Lab.	1
Min. 9-Preparation of Coal and Ore	3	Min. 15 - Mine Ventilation	2
Min. 41-Mining Design	3	Min. 21-Examination,Valuation, and Reports	3
Min. 99 - Inspection Trip	0	Min. 42-Mining Design	2
Option (See page 148)	8 or 9	Min. 90-Seminar	1
		Option (See page 148)	6-8
	17 or 18		17-19

OPTIONS FOR THE CURRICULUM IN MINING ENGINEERING

COAL MINING OPTION

THIRD YEAR

FIRST SEMESTER		SECOND SEMESTER	
Accy. 12-Fundamentals of Accounting	3	M.E. 62-Mech. Eng. Laboratory	3
Approved Elective	3	Approved Elective	2

FOURTH YEAR

Met. 1-Elements of Metallurgy	3	Met. 13-Utilization of Fuels	3
Min. 6-Mech. Eng. of Mines	3	Min. 20-Mine Ventilation Lab.	2
Min. 8-Mine Administration	3	Min. 64-Coal and Ore Prep.Lab.	2

ORE MINING OPTION

THIRD YEAR

Accy. 12-Fundamentals of Accounting	3	M.E.62-Mech. Eng. Laboratory	3
Approved Elective	3	Approved Elective	2

FOURTH YEAR

Met. 1 - Elements of Metallurgy	3	Geol. 96-Economics Geology	3
Met. 3 - Fire Assaying	2	Min. 6-Mech. Eng. of Mines	3
Min. 8-Mine Administration	3	Min. 64-Coal and Ore Prep. Lab.	2

MINING GEOLOGY OPTION

THIRD YEAR

Geol. 2a-Historical Geology	4	Geol. 49-Microscopic Mineralogy	5

[illegible]

Approved Elective	2	Approved Elective	2

FOURTH YEAR

Geol. 95-Economic Geology	3	Geol. 96-Economic Geology	3
Met. 3-Fire Assaying	2	Min. 12-Mining Geology	3
Approved Elective	3		

MINE ADMINISTRATION OPTION

THIRD YEAR

Accy. 12-Fundamentals of Accounting	3	Econ. 3--Money, Credit, and Banking	3
Econ. 2-Elements of Economics	3	Approved Elective	2

FOURTH YEAR

Econ. 35-Corporation Finance	3	Min. 6-Mech. Eng. of Mines	3
Min. 8-Mine Administration	3	Approved Elective	3
Eng. 92-Engineering Law	3		

CURRICULUM IN METALLURGICAL ENGINEERING

For the Degree of Bachelor of Science in Metallurgical Engineering

FIRST YEAR

Common Program for Freshmen (page 196), except that Chem. 5 and Math. 10a-10b are substituted for Chem. 4 and Math. 2, 4, 6a.

SECOND YEAR

FIRST SEMESTER		SECOND SEMESTER	
Chem. 22-Quantitative Analysis	5	C.E. 15-General Surveying	3
Math. 8a-Differential Calculus	3	Math. 8b-Integral Calculus	3
Phys. 1a-General Physics	4	M.E. 85-Pattern and Foundry Lab.; or German or French	3 or 4
Phys. 3a-Physics Laboratory	1	Phys. 1b-General Physics	4
Physical Education	½	Phys. 3b-Physics Laboratory	1
Military Science (for men)	1	T.A.M. 1-Analytical Mechanics	2
Approved Elective or German or French	3 or 4	Physical Education	½
		Military Science (for men)	1
Total	17½ or 18½	Total	17½ or 18½

THIRD YEAR

Cer.E. 21-Pyrometry	1	Chem. 48b-Physical Chemistry	3
Chem. 48a-Physical Chemistry	3	Met. 5 - Ferrous Metallurgy	3
Geol. 20 - Mineralogy	3	Met. 6 - Metallurgical Calculations	2
Met. 2-Principles of Metallurgy	3	Met. 13-Utilization of Fuels	3
Met. 4-Physical Metallurgy	3	M.E. 62-Mech. Eng. Lab.	3
Min. 9 -Principles of Mineral Dressing	3	T.A.M. 3-Resistance of Materials	3
T.A.M.-2-Analytical Mechanics(Dynamics)	3	T.A.M. 63-Resistance of Materials Lab.	1
	19		18

FOURTH YEAR

FIRST SEMESTER		SECOND SEMESTER	
E.E.4-D.C. and A.C. Circuits and Machines	2	E.E.5-Applications of Electrical Equipment	2
E.E.64-D.C. and A.C. Circuits and Machines Laboratory	1	E.E.65-Electrical Equipment Lab.	1
Met. 7-Ferrous Metallography	3	Met. 10-Non-ferrous Metallography	3
Met. 8-Ferrous Metallography Lab.	2	Met. 11-Electrometallurgy	3
Met. 9-Non-ferrous Metallurgy	3	Met. 42-Metallurgical Design	2
Met. 41-Metallurgical Design	3	Min. 2-Mining Principles or Approved Elective	3
Met. 99-Inspection Trip	0	Min. 90-Seminar	1
Approved Elective	2	T.A.M. 4-Hydraulics	2
		T.A.M. 64-Hyrdaulics Laboratory	1
Total	16	Total	18

Engineering Physics.-The Department of Physics offers a curriculum in engineering physics, designed to give students the broad and thorough training in fundamental physics and mathematics that is demanded by the increasing complexity of modern engineering practice. The work of the first two years as much like that in the other engineering curricula. The work in the last two years includesadvanced courses in physics, mathematics, and chemistry, but there is a liberal allowance of time for study of any field of engineering in which the student is especially interested. The details of technical applications are left to be learned in connection with a particular job; or, if the electives are properly selected, the curriculum may be made a basis for graduate work in some particular field of engineering or of physics. The curriculum as arranged in 1941-42, is given below:

CURRICULUM IN ENGINEERING PHYSICS

For the Degree Bachelor of Science in Engineering Physics

FIRST YEAR

Common Program for Freshmen (~~page~~ 136), except that substitution of Chem. 6 for Chem. 4 is advised.

SECOND YEAR

FIRST SEMESTER		SECOND SEMESTER	
German or Approved Elective	4	German or Approved Elective	4
Math. 7-Differential Calculus	5	Math. 9-Integral Calculus	3
Phys. 1a-General Physics	4	Phys. 1b-General Physics	4
Phys. 3a-Physics Laboratory	1	Phys. 3b-Physics Laboratory	1
Physical Education	½	T.A.M. 1-Analytical Mech.(Statics)	2
Military Science (for men)	1	Physical Education	½
Approved Elective	3	Military Science (for men)	1
		Approved Elective	3
Total	18½	Total	18½

THIRD YEAR

E.E.25-Introduction to Circuit Analysis	4	E.E. 26-Direct Current Apparatus	3
E.E.75-Electrical Engineering Lab.	2	E.E. 76-Electrical Engineering Lab.	3
German or Approved Elective	4	German or Approved Elective	4
Math.18-Advanced Calculus	3	Math. 19-Advanced Calculus	3
Phys. 20a-Theoretical Mechanics	3	Phys. 20b-Theoretical Mechanics	3
Phys. 40a-Elec. and Magnetism	3	Phys. 40b-Elec. and Magnetism	3
Total	19	Total	18

FOURTH YEAR

Chem. 40-Physical Chemistry	3	Phys. 60-Heat (M.E.10 or 13 may be substituted	3
Phys. 71a-Light	2	Phys. 71b-Light	2
Phys. 72a-Light Laboratory	2	Phys. 72b-Light Laboratory	2
Phys. 199-Colloquium	0	Phys. 199 - Colloquium	0
Approved Elective	3	Approved Elective	3
Technical Option	6	Technical Option	5
	16		15

e. NEW CURRICULA AND CURRICULAR REVISIONS FOR 1944

Curriculum in Mining Engineering Revised.-In 1944, the mining-engineering curriculum was revised to include one integrated curriculum in place of the four options previously offered,-the new arrangement laying special emphasis on coal mining, because of its importance in the State, although giving adequate preparation to metal mining. The new curriculum with mining courses renumbered appears as follows:

FIRST YEAR

The common program of all engineering freshmen.

SECOND YEAR

FIRST SEMESTER		SECOND SEMESTER	
Geo. 43-Engineering Geology	3	Geol. 20-General Mineralogy	3
Math. 7 - Calculus	5	Math. 9 - Calculus	3
Min. 1 - Elements of Mining	4	Min. 2 - Mining Methods	4
Phys. 1a-General Physics	4	Phys. 1b-General Physics	4
Phys. 3a-Physics Laboratory	1	Phys. 3b-Physics Lab.	1
Physical Education	½	T.A.M. 1-Analytical Mechanics(Statics)	2
Military Science	1	Physical Education	½
		Military Science	1
	18½		18½

THIRD YEAR

C.E. 15-General Surveying	3	Econ. 41-Introduction to Labor Problems, or	
Econ. 2-Elements of Econ., or Advanced Military	3	Econ. 43 - Personnel Admin., or Advanced Military	3
Min. 10-Haulage, Hoisting,&Drainage	4	Geology Elective	2 or 3
T.A.M. 2-Analytical Mechanics(Dynamics)	3	M. E.62-Mechanical Engin.Laboratory	3
T.A.M. 4-Hydraulics	2	Min. 11 - Mine Ventilation	2
T.A.M. 64-Hydraulics Lab.	1	Min. 12 - Mine Surveying	2
		T.A.M. 3-Resistance of Materials	3
		T.A.M. 63-Resistance of Materials Lab.	1
	16		16 or 17

Summer

First Week

Mining 61-First Aid and Mine Rescue 1

Second and Third Weeks

Mining 62-Summer Mine Surveying 2

FOURTH YEAR

FIRST SEMESTER		SECOND SEMESTER	
C.E.89-Structural Engineering or M.E. 87-Machine Tool Laboratory	3	E.E.12-Direct and Alternating Current Apparatus	3
E.E. 11-Direct and Alternating Current Circuits	3	E.E. 62-Direct and Alternating Current Laboratory	1
E.E. 61-Direct and Alternating Current Laboratory	1	Met. 1-Elements of Metallurgy	3
Min. 20-Mine Administration	3	Min. 23-Examination and Valuation	2
Min. 21 - Mineral Dressing	3	Min. 24-Mine Design	3
		Min. 25-Coal Preparation	2

Min. 22 - Fuels	3	Approved Elective	3 or 4
Min. 99-Mining Inspection Trip	0		
	16		17 or 18

Mining 61 (First Aid), a new course, taught by specialists employed by the State Department of Mines and Minerals at its Springfield Mine Rescue Station, requires 48 clock hours during one week of the summer vacation. Mining 62 (Summer Surveying), another new course, taught by a member of the mining staff here, requires about eight days of actual underground surveying work. The rest of the time allotted to it is spent in the preparation of maps and notes.

Aeronautical Engineering.-The new curriculum in aeronautical engineering was formulated on the same general level of scope, and content as those of the other departments in the College of Engineering; that is, to provide training in the fundamental principles of engineering science and the application of these principles to problems relating to a particular field in engineering. Emphasis on fundamentals is especially important in this case because the newness of aviation makes it difficult to predict what developments the industry will undergo in the days to come. The unusual advancement within recent years of this branch of transportation calling for unprecedented quantities of airplanes and airplane facilities, has required a vast accumulation of production plants devoted to the design, production, and fabrication of aircraft equipment and appliances and of experimental laboratories dedicated to the development of new principles upon which to found this new science of aerodynamics or to a better understanding and application of those already established. This extensive program of engineering production has required an immense supply of trained personnel necessary not only to serve in all stages of the production and experimental programs, but also to carry on the educational training itself. In the light of this demand, this curriculum has been devised to provide systematic instruction for those students who desire to prepare themselves for positions associated with this particular field of the engineering profession.

First Curriculum in Aeronautical Engineering.-The following curriculum, the first organized four-year course of study leading to the B.S. degree in Aeronautical

Engineering at the University of Illinois, became effective on November 2, 1944,-the date of the beginning of the academic year 1944-45. Due to lack of time, facilities, and personnel, however, only the first five semesters of the schedule were made available for registration purposes at that date. The program of the freshman year is identical with most of the others in the College,-chemistry, drawing, mathematics, and rhetoric being the basic-training subjects. The work of the second year continues with mathematics and takes up courses in physics, mechanics, speech, shop work, and a new course in aircraft drafting and lofting. Courses in mathematics, mechanics, and rhetoric carry over into the junior year, which contains in addition several subjects in electrical and mechanical engineering along with three new courses in aeronautical engineering. The fourth year is devoted almost entirely to technical subjects dealing with some phase of instruction in applied aeronautics.

FIRST YEAR
Common Program for Freshmen

FIRST SEMESTER		SECOND SEMESTER	
Chem. 2 or 3-Inorganic Chemistry	3 or 4	Chem. 4-Metallic Elements	4
G.E.D. 1 or 4-Elements of Drawing	4	G.E.D. 2 -Descriptive Geometry	4
Math. 2-Advanced Algebra	3	Math. 6a-Analytic Geometry	4
Math. 4 or 5 - Trigonometry	2	Rhet. 2-Rhetoric and Composition	3
Rhet. 1-Rhetoric and Composition	3	Hygiene	2
Physical Education	½	Physical Education	½
Military Science (for men)	1	Military Science (for men)	1
	16½ or 17½		18½

SECOND YEAR

G.E.D.3-Aircraft Drafting and lofting	2	Math. 9 - Integral Calculus	3
Math. 7 - Differential Calculus	5	M.E.82-Machine Tool Laboratory	1
M.E.81-Pattern,Foundry, and Welding ~~welding~~ Laboratory	2	Physics 1b-General Physics	4
Physics 1a-General Physics	4	Physics 3b-Physics Laboratory	1
Physics 3a-Physics Laboratory	1	Speech 1-Prin. of Effective Speaking	3
Non-technical Elective	2	T.A.M. 1-Anal. Mech. (Statics)	2
Physical Education	½	T.A.M. 2-Anal. Mech. (Dynamics)	3
Military Science	1	Physical Education	½
		Military Science	1
	17½		18½

THIRD YEAR

Aero.E.1-Aerodynamics	3	Aero.E.2-Aircraft Materials and Processes	3
Econ. 2-Elements of Economics, or Eng. 10-Engineering Economics	3	Aero. E.22-Aircraft Structures	3
Math. 16-Differential Equations	3	E.E. 18-Electrical Circuits	2
Rhet. ~~x~~-Composition (Report Writing)	2	E.E. 68-Electrical Circuits Lab.	1
T.A.M. 3-Resistance of Materials	3	M.E. 13-Thermodynamics	3
T.A.M.5-Fluid Mechanics	3	Approved Elective	3

[illegible]

[illegible]

[illegible]	[illegible]

[illegible]

[illegible]	[illegible]

[illegible]

[illegible]	[illegible]

T.A.M. 63-Resistance of Materials Lab.	1	M.E. 32-Kinematics and Dynamics of Machinery	3
	18		18

FOURTH YEAR

Aero.E.23-Aircraft Structures	3	Aero. E.44-Airplane Design	3
Aero. E. 33-Aircraft Detail Design	2	Aero. E.62-Aerodynamics Lab.	2
Aero. E. 43-Airplane Design	3	Aero.E.64-Aircraft Structures Laboratory	1
E.E. 19-Aeronautical Electrical Equipment	3	Aero. E. 66-Aircraft Engine Lab.	2
M.E. 9-Internal Combustion Engines	3	Eng. 92-Engineering Law	3
Technical Option	3	Approved Elective	3
Inspection Trip	0	Technical Option	3
Total	17	Total	17

CHAPTER XXIII

WARTIME TRAINING IN ENGINEERING

A. WORLD WAR I

General.-Since a complete and elaborate record of the part taken by the University in World War I is presented in a "Military History of the University of Illinois, 1868-1923," by George Chapin, L.A.& S. '06, only a resume of the special work of the College of Engineering during that period is presented here.

Intercollegiate Intelligence Bureau.-On March 3, 1917, a branch of the Intercollegiate Intelligence Bureau was organized at the University with Assistant Professor H. W. Miller, Assistant Dean of the College of Engineering, as Adjutant. The object of the Bureau was to bring all the College and University agencies into direct contact with the proper department of the Federal Government. Questionnaires were promptly sent to 13 500 alumni and students, and the information received from these was placed upon permanent record cards under 102 general heads. Within 30 days after the United States declared war, 3,860 of these cards were upon file and ready for use. To the first emergency call from the United States Civil Service Commission, Illinois responded with a list of names, and several men immediately began work in the positions offered. Urgent calls also came from the Ordnance Department for trained inspectors, clerks, and instrument men.

On May 9, 1917, the Bureau was asked to recruit from the University two ambulance units, and on May 26, an additional unit was called for; and on July 2, the three units, consisting of 108 men of whom 88 were Illini alumni or students, entrained for Allentown, Pennsylvania, for a preliminary army training prior to departure for France.

In the latter part of August, the Federal Government announced that it would increase its program in aviation, shipbuilding, ordnance, chemistry, and finance; and for five or six months thereafter, the Bureau, under the direction of Adjutant H. H. Jordan, Assistant Dean of the College, who had succeeded Adjutant Miller when he left the University for service in the field, was busy supplying names for military and naval positions, giving information concerning the organization of

the different national departments, and the work of the officers' training schools. In March, 1918, the Bureau was merged into the War Service Exchange under the direction of the Adjutant General's Office, and the University ceasedto function in this line.

School of Military Aeronautics.-On May 1, 1917, the Board of Trustees authorized the establishment of the School of Military Aeronautics under Government direction for giving ground training in preparation for flying. As the College had already begun work in this field, having established a Chair of Aeronautics in 1916, the School was placed under the general supervision of Dr. C. R. Richards, Dean of the College, and under the immediate charge of Assistant Dean Miller as Director of Technical Instruction. Instructional practice began on May 21, 1917, but Director Miller resigned on September 1, 1917, to enter field military service. After an interval, Professor F. D. Crawshaw, former Assistant Dean of the College, was made Director of Technical Instruction and President of the Academic Board, and remained in that position until the disbandment of the School after the signing of the armistice.

From May 20, 1917, until Armistice Day, the Federal Government sent to the School each week a group of men enlisted in the Aviation Corps. The course of study first prescribed for these men was of eight weeks duration; but in March, 1918, the Government extended this period to twelve weeks, and doubled the weekly class enrollment. The curriculum included the construction and operation of machine guns and aircraft engines, the rigging of airplanes, artillery observation, wireless telegraphy, map reading, reconnaissance, meteorology, astronomy, contact patrol, bombing, cross-country flying, theory of flight, types of machines, military law, military hygiene and sanitation, infantry-drill regulations, army regulations, paper work, and the military organization of the German, British, French, and American armies. The instruction was given by regular instructors of The College of Engineering and others employed for that purpose. At first, the cadets were quartered and instructed in the new Armory; but a little later, the men,

the Northern railroad departments, and the work in the vocational courses expanded. In March, 1918, the [illegible] and [illegible] that the [illegible] under the direction of the Adjutant General's Office, and [illegible] [illegible] in this line.

School of Military Aeronautics.--On May 1, 1917, the Board of Trustees authorized the establishment of the School of Military Aeronautics under Government direction for giving ground training to prospective air pilots. As the college had already done work in this field, having established a Chair of Aeronautics in 1916, the School was placed under the general supervision of Dean C. R. Richards, Dean of the College, and under the immediate charge of Assistant Dean Willard as Director of Technical Instruction. Instructional practice began on May 21, 1917, and Director Willard resigned on September 1, 1918, to enter field military service. Prior to [illegible], Professor H. H. Jordan, former Assistant Dean of the College, was made Director of Technical Instruction and President of the Academic Board, and remained in that position until the discontinuance of the school after the signing of the armistice.

From May 21, 1917, until Armistice Day, the Federal Government sent to the School each week a group of men enlisted in the aviation corps. The course of study first prescribed was [illegible] weeks and one of eight weeks duration; but in March, 1918, the Government extended this period to twelve weeks, and limited the weekly [illegible] enrollment. The curriculum included the construction and operation of engines and the aircraft [illegible], the rigging of airplanes, artillery observation, airplane telegraphy and reading, [illegible], [illegible], [illegible], [illegible], cross-country flying, theory of flight, types of machines, military law, military hygiene and sanitation, infantry drill regulations, army [illegible], paper work, and the military organization of the German, British, French, and American armies. The instruction was given by regular instructors of the College of Engineering and others employed for that purpose. At first, the students were quartered and instructed in the new Armory and a [illegible], but

were quartered in the Y.M.C.A. Building, which had been converted into a barracks, and still later detachments were stationed in the Woman's Residence Hall. The instruction was given mostly in the Transportation Building, in the old Armory, and in an annex built to it for that purpose, known as the Gas Engine Annex. Simultaneously with the technical work enumerated above, the cadets had military training under army officers. Upon completing their course at the University, the cadets were trained in the actual use of the airplane at the various aviation flying fields.

The School began with 25 cadets; and the maximum attendance at any one time was 836 for the week ending July 22, 1918. A new squadron was received and a new class was graduated each week. During the eighteen months the School was in operation, 2,691 cadets were graduated, 596 were discharged, and at the close of the School 338 were on the roll. In all 3,625 men received instruction.

Students' Army Training Corps.-The Students' Army Training Corps was created by the War Department for the purpose of educating and training men for service in the U. S. Army, with the particular reference to the selection and training of candidates for commissioned and non-commissioned officers, and for the needs of expert technical war work. Units were established in 550 educational institutions throughout the United States. Members of the Corps had to be over 18 years of age and under 21. Many of the regular students of the University were enrolled in the Corps, which was usually referred to as the S.A.T.C. The Corps was divided into two classes, A and B, the former must have been graduates of a high school and must have received academic training, while the latter must have completed the eighth grade and must have received instruction in mechanical trades. The unit established at the University of Illinois was wholly A. It was organized on October 1, 1918, and started work at once. There were enrolled in Urbana 2,600 students in the army section, and 400 in the navy section. In the Chicago College of Medicine, there were enrolled 385 in the medical section.

In Urbana, each cadet was required to give eleven hours per week to military drill and instruction, nine to military law and practice, three to War Aims of the

United States ("War Issues"), and ten to thirteen to regular college work. Of the latter, several subjects were prescribed for each of the different branches of the service, and the remainder were elective. The cadet elected the branch of the service he preferred,-and a large proportion took trigonometry, surveying, map making, and physics, with a substantial part of the teaching of these subjects devolving upon the engineering instructors. Considerable numbers of cadets enrolled in accountancy, business management, economics, and sanitation and hygiene, and as all cadets were required to take War Issues, nearly all of the older men in the University faculty were called upon to teach one or more sections in that subject.

The University thus became virtually a military school.[1] Although more than two-thirds of the usual courses were given, emphasis was placed on the several special courses required by the Government, for it was virtually in charge of the curricula. All members of the Corps were under military discipline, living in barracks, wearing uniforms, and having their daily programs regulated by officers. Under such conditions, the usual life of the University was not possible, and from the first of October until late in December, when the affair was over, few of the characteristic features of campus life were in evidence. The armory was converted into an immense barracks by constructing a temporary second floor, affording room for more than fifteen hundred men, with a mess hall below for all members of the Corps.

All fraternity and many rooming houses were converted into barracks, also, and such men as were not in the Corps lived where they could find room. The labor of preparing barracks and mess facilities for this number of men was tremendous, but it was performed rapidly. To add to the difficulties of the situation, an epidemic of influenza made it necessary to provide hospital facilities for more than three hundred patients at a time when all was in confusion of change and reorganization.

The Corps was demobilized on December 21, 1918. The net result of what might

1. Much of the following material was taken from the University of Illinois Alumni Record, 1918, pages XXIX and XXX.

United States ("the Corps"), and was to introduce to regular college work. Of the latter, several subjects were prescribed for each of the different branches of the service, and the remainder were electives. The point aimed at the length of the service to be rendered, and a large proportion took telegraphy, surveying, map making, and physics, with a substantial part of the teaching of these subjects devolving upon the engineering instructors. Considerable numbers of cadets enrolled in accountancy, business management, economics, and sanitation and hygiene, and as all cadets were required to take War Issues, nearly all of the older men in the University faculty were called upon to teach one or more sections in that subject.

The University thus became virtually a military school.[1] Although more than two-thirds of the usual courses were given, emphasis was placed on the several special courses required by the Government, for it was virtually in charge of the curricula. All members of the Corps were under military discipline, living in barracks, wearing uniforms, and having their daily programs regulated by officers. Under such conditions, the usual life of the University was not possible, and from the first of October until late in December, when the affair was over, few of the characteristic features of campus life were in evidence. The Armory was converted into an immense barracks by constructing a temporary second floor, affording room for more than fifteen hundred men, with a mess hall below for all members of the Corps.

All fraternity and many rooming houses were converted into barracks, also, and such men as were not in the Corps lived where they could find room. The task of converting barracks and mess facilities for this number of men was tremendous, but it was performed rapidly. To add to the difficulties of the situation, an epidemic of influenza made it necessary to provide hospital facilities for more than three hundred patients at a time when all was in confusion of change and reorganization.

The Corps was demobilized on December 21, 1918. The net result of what might

1. Much of the following material was taken from the University of Illinois Alumni Record, 1918, pages XXII and XXX.

have proved to be an interesting experiment under more moderate conditions, was very unsatisfactory, for three reasons. The period of experiment was too short, the preparation of quarters required too much time, and the influenza added to the confusion. Few who had any part in the conduct of the ordeal, remember the experience as anything but a nightmare.

After the demobilization in December, the University decided to operate on the quarter plan for the year 1918-19; and the second term opened early in January. Registration was reduced somewhat, and the University gradually returned to normal conditions. Students gradually resumed their old way of campus life, and by the end of the year, there was little to remind one that there had ever been an S.A.T.C. at Illinois.

War-Service Records.-Table XXIV, which was prepared by Professor T. A. Clark,Dean of Men, shows the number of University men of the different colleges who enlisted during World War I. The number of men in the College of Engineering ranks first; but this had no significance since there are no data as to the number of men eligible for military service in the several colleges.

It is interesting to note that a very large percentage of the enlisted men were officers. In the army, there were 5,353 men of whom 2,923 were commissioned officers (ranging from 2 major generals to 1,317 second lieutenants), 870 non-commissioned, and 1,560 enlisted men. In the marine corps, there were 90 men of whom 25 were commissioned officers, 31 non-commissioned officers, and 34 enlisted men. In the navy, there were 838 men of whom 263 were commissioned officers, 120 petty officers, 447 enlisted men,and 8 mid-shipmen. There were 24 engaged in Y.M.C.A. work. In other words, of the 6,281 University of Illinois men in combatant military service, 52.9% were commissioned officers.

The total number of ~~men known to date of~~ Illini men who died while in service or whose deaths were due to injuries or illness contracted while in service, was 181, of whom 62 were engineers. The total number wounded whose injuries were severe enough to confine them to a hospital was 158.

have proved to be an interesting experiment under more academic conditions, was very unsatisfactory, for three reasons: the period of experiment was too short, the preparation of teachers required too much time, and the influenza added to the confusion. The men had any part in the conduct of the school, regarded its professors as anything but a nuisance.

After the demobilization in December, the University decided to organize on the quarter plan for the year 1918-19; and the second term opened early in January. Registration was reduced somewhat, and the University gradually returned to normal conditions. Students gradually resumed their old way of campus life, and by the end of the year, there was little to remind one that there had once been an S.A.T.C. at Illinois.

Distribution [illegible] (Table XXIV), which was prepared by Professor [illegible], of the [illegible], shows the number of University men of the different colleges who enlisted during World War I. The number of men in the College of Engineering seems [illegible] but this has no significance since there are no data as to the number of men eligible for military service in the several colleges.

It is interesting to note that a very large percentage of the enlisted men were officers. In the army, there were [illegible] men of whom [illegible] were commissioned officers (ranging from [illegible] major generals to [illegible] second lieutenants), [illegible] non-commissioned, and [illegible] enlisted men. In the marine corps, there were [illegible] men of whom [illegible] were commissioned officers, [illegible] non-commissioned officers, and [illegible] enlisted men. In the navy, there were [illegible] men of whom [illegible] were commissioned officers, [illegible] petty officers, [illegible] enlisted men, and [illegible] midshipmen. [illegible] in Y.M.C.A. work. Of those [illegible], of the [illegible] University of Illinois men in national military service, [illegible] were commissioned officers.

The total number of men known to [illegible] of Illini men who died while in service or whose deaths were due to injuries or illness contracted while in service, was [illegible], of whom [illegible] were engineers. The total number reported whose injuries were severe enough to entitle them to a wound stripe was [illegible].

TABLE XXIV - NUMBER OF UNIVERSITY MEN ENLISTED IN WORLD WAR I

College	Total	Under Grad.	Former Students	Alumni	Post Grad	Staff and Faculty
Engineering	1 997	480	439	1 018	19	41
L.A. & S.	1 518	408	380	567	66	97
Agriculture	1 210	371	339	472	11	17
Commerce	826	393	178	237	10	8
Pharmacy	262	67	58	135	2	-
Law	212	41	55	155	-	1
Medicine	137	55	12	49	11	10
Dentistry	124	30	-	92	-	2
Administration	19	-	-	-	-	-
Total	6 305	1 845	1 461	2 685	119	195

B. WORLD WAR II

General.-A University War Committee with Provost Harno as chairman was appointed by President Willard on December 27, 1941, to act as a central agency for studying and coordinating the University's resources to meet the national emergency occasioned by World War II. At once the committee began to develop a program for the mobilization of the University's resources along lines of curricular activities, research, the protection of life and property, and to provide an information center for students.

Accelerated Schedule of Instruction.-"To prepare men and women as rapidly as possible for many professions important to the prosecution of the war, the University's schedule of instruction is accelerated, without reducing the amount or quality of work required for graduation. Also for this purpose the admission requirements are modified so that high-school seniors of high rank, who pass certain tests, may enter the University as freshmen at the beginning of any term.

"In the summer of 1942 the colleges and schools at Urbana offered, in addition to courses only six weeks long, many courses extending for twelve weeks in which students could earn as much credit as in a regular semester. In February, 1943, the Urbana departments began to operate on an annual schedule of three terms of sixteen weeks, instead of two semesters of eighteen weeks and a short summer session. Students may thus complete within three years a curriculum fully

equivalent to that formerly requiring four years."[1]

Engineering Instructors on Leave for War Service.-Early in the war period, many persons connected with the staff of the College of Engineering obtained a leave of absence from their University duties to enlist with the Armed Forces or to engage in some phase of essential war industry. Others left later, so that in 1945, the total number on leave is about fifty of grade of instructor or higher. There is no available record of the number who resigned their positions to enter military service or take appointments in essential war production. Many persons below the rank of instructor either obtained leave or resigned their positions to enlist or take employment in war-service industries.

Civilian Training.-During the period of the war, the regular curricula scheduled for civilian training were carried on as usual by the several departments within the College of Engineering for men who were below the draft-limit age or who were otherwise unqualified for the armed service. In many cases, especially in the early days of the war, both civilians and enlisted men attended the same classes. The number of sections was materially reduced, however, and in many instances elective courses were not offered.

C. A. A. War Training Service-In 1942, the Pilot Training Course previously mentioned, was accelerated under Civil Aeronautics Administration. The program, later designated the C.A.A. War Training Service, consisted of eight-weeks sessions in which enrollees received 240 hours of ground schooling and from 35 to 40 hours of flight instruction. After January 1, 1943, classes in aviation were composed of Air Corps Cadets in the Navy V-5 program. This work was later transferred to the Navy V-12 program.

Reserve Officers' Training Corps.-After the declaration of war, the work of the Reserve Officers' Training Corps was accelerated to synchronize with the University's three-semester program. During 1943-43, over three times the usual number of men were qualified for commissions at the time of graduation.

1. Annual Register, 1942-1943, page 117.

equivalent to that formerly requiring four years.[1]

Engineering Instructors on Leave for War Service.--Early in the war period, many persons connected with the staff of the College of Engineering obtained a leave of absence from their University duties to enlist with the Armed Forces or to engage in some phase of essential war industry. Others left later, so that in 1943, the total number on leave is about fifty of grade of instructor or higher. There is no available record of the number who resigned their positions to enter military service or take appointments in essential war production. Many persons below the rank of instructor either obtained leave or resigned their positions to enlist or take employment in war-service industries.

Civilian Training.--During the period of the war, the regular curricula scheduled for civilian training were carried on as usual in the several departments within the College of Engineering for men who were below the draft-limit age or who were otherwise unqualified for the armed services. In many cases, especially in the early days of the war, both civilians and enlisted men attended the same classes. The number of students was materially reduced, however, and in many instances elective courses were not offered.

C. A. A. War Training Service.--In 1940, the Pilot Training Course previously mentioned, was coordinated under Civil Aeronautics Administration. The program, later designated the C.A.A. War Training Service, consisted of eight-week sessions in which enrollees received 240 hours of ground schooling and from 35 to 40 hours of flight instruction. After January 1, 1943, classes in aviation were composed of Air Corps Cadets in the Navy V-5 program. This work was later transferred to the Navy V-12 program.

Reserve Officers' Training Corps.--After the declaration of war, the work of the Reserve Officers' Training Corps was accelerated to synchronize with the University's three-semester program. During 1942-43, over three times the usual number of men were qualified for commissions at the time of graduation.

1. Annual Register, 1942-1943, page 141.

After the Army Specialized Training Program[1] was instituted in April 1943, under authority of the Selective Service Act, the advanced phase of the R.O.T.C. was discontinued for the period of the war to make place for the programs described in the next section.

Army Specialized Training Program.-The following statement from the 1943-44 Register[2] explains in some detail the operation of the advanced-training program substituted for the R.O.T.C.:

"The University of Illinois has two Units operating under the Commandant for administration and military training. The Specialized Training and Reclassification Unit (STAR) which receives enlisted men who are candidates for the program, tests them and classifies them for their proper place in the program, rejects those not qualified, and transfers, under direction of the War Department, the successful candidates to institutions where vacancies exist. The regular A.S.T.P. Unit covers the fields of engineering and languages. The basic engineering is essentially the same as the freshman and sophomore work; the advanced engineering corresponds to the junior and senior work. The Areas and Languages courses correspond to junior and senior work for men who are fluent in a foreign language. There is also a section which corresponds to graduate work both in engineering and language."

Further information regarding the nature of the special training program, although repeating to some extent, is provided in the following excerpt from the 1943-44 Register:

"An Army Specialized Training, Assignment, and Reclassification Center (STAR) was opened at the University in April, 1943. This program is designed to test the ability and knowledge of Army trainees who have previously passed a preliminary screening test, and to direct them into those curricula in the Army Specialized Training Program (ASTP) for which they are best prepared. They have already received their basic military training. After three days of testing, the trainees needing them are given refresher courses in mathematics, physics, and chemistry. Those possessing the necessary qualifications are then sent to appropriate ASTP schools for further training. Soldiers in the STAR unit are quartered in Newman Hall and messed at the Ice Rink.

"During the summer, fall, and winter of 1943, the University had one of the largest ASTP units in the country, with an enrollment of 3,383 students on the Urbana campus during the peak period of November, 1943............The purpose of this program was to provide a continuous and accelerated flow of high-grade technicians and specialists needed by The Army in fields where the output of its own training schools was insufficient in extent or character. Curricula and course materials were prescribed by the Army, and Army officers handled the administrative and military phases of the program. The men were housed in fraternities and ate in the Ice Rink, which was converted by the University into a mess hall. Instruction was given by the regular faculty in University classrooms. The ASTP term was a twelve-week period with an interval of one week between terms. The number of terms varied according to curricula, and the program was divided into two phases--basic and advanced. A small number of students with training equivalent to or beyond the scope of the ASTP was also being prepared in a special ad-

1. In February, 1943, a joint committee of the Army,Navy,and the U.S.War Manpower Commission designated the University of Illinois as one of the institutions for the training of engineers and other specialists in the Army and Navy College Programs.
2. Page 220.

After the Army Specialized Training Program was instituted in April 1943, under authority of the Selective Service Act, the extended phase of the E.S.M.W.T. was discontinued for the period of the war to make place for the program described in the next section.

<u>Army Specialized Training Program</u>.—The following excerpt from the 1943-44 Register[1] explains in some detail the operation of the advanced-training program established for the A.S.T.P.:

"The University of Illinois has two kinds of training under the Department for [illegible] and [illegible] training. The Specialized Training and Reclassification [illegible] ... [illegible] the program [illegible] under direction of the War Department, the [illegible] to institutions whose [illegible]. The program A.S.T.P. [illegible] the fields of engineering and languages. The basic engineering is essentially the same as the freshman and sophomore work; the advanced engineering corresponds to the junior and senior work. [illegible] There is also a [illegible] which corresponds to graduate work both in engineering and language."

Further information regarding the nature of the special training program, [illegible], is provided in the following excerpt from the 1943-44 Register:

"The Army Specialized [illegible], Assessment, and Classification Center (STAR) was opened at the University in April, 1943. This program is designed to test the ability and knowledge of army trainees who have previously passed a preliminary screening test, and to direct them into those curricula in the Army Specialized Training Program (ASTP) for which they are best prepared. They have already received basic military training. After three days of testing the trainees [illegible] are given refresher courses in mathematics, physics, and chemistry. Those possessing the necessary qualifications are then sent to engineering ASTP schools for further training. Trainees in the STAR unit are quartered in [illegible] Hall and [illegible]."

"During the summer, fall, and winter of 1943, the University had one of the largest ASTP units in the country, with an enrollment of 1,797 students on the [illegible] campus during the peak period of December, 1943............The purpose of this program was to provide a continuous and accelerated flow of high-grade technicians and specialists needed by the Army in fields where the output of the [illegible] was insufficient [illegible]. Curricula and course materials were prescribed by the Army, and Army officers handled the administrative and military phases of the program. The men were housed in [illegible] and [illegible] which was [illegible] by the University [illegible]. Instruction was given by the regular faculty in University classrooms. The ASTP term was [illegible] weeks [illegible]. The [illegible] according to curriculum, and the program was divided into [illegible]. A small number of students with [illegible] of the ASTP was [illegible]. In February, 1944, a [illegible] of the [illegible] and the U.S. [illegible] the University of Illinois as one of the institutions for the training of engineers and other specialists in the Army and Navy College Programs.

2. Page 238.

vanced curriculum corresponding to graduate work.

"The work load of the ASTP trainee included approximately 59 hours of supervised activity a week. A minimum of 24 hours was spent in the classroom with 24 hours of supervised study, five hours of military instruction, and six hours of physical training. This strenuous program compressed a year and a half of college work into nine months. Studying in the basic phase on the Urbana campus were premedical, predental, and general engineering students. The premedical and predental work followed the usual course plan of these fields; in general engineering it included English, history, geography, mathematics, physics, chemistry, and engineering drawing. In the advanced phase men were assigned to curricula in premedical, predental, and foreign area and language studies, and to civil, mechanical, electrical, and sanitary engineering. Special advanced curricula were administered in engineering and in language and foreign area studies. The social, political, and economic conditions, and the historical background of approximately fifteen different foreign areas were studied at the University. Some soldier-students concentrated particularly on language, while others divided their attention between language and area studies. French, Spanish, German, and Italian were the principal languages taught; however, other languages were taken by many of the special advanced group."[1]

ASTP Curricula.- The several engineering curricula provided for the ASTP are indicated in the following outlines. The terms ran from July 12 to October 30, 1943; from November 8, 1943 to January 29, 1944; from February 7, to April 29, 1944; from May 8 to July 29, 1944; from August 7 to October 28, 1944; from November 6, 1944, to January 27, 1945; and from January 8 to March 31, 1945.

ARMY SPECIALIZED TRAINING PROGRAM

CURRICULUM BE-1

BASIC PHASE ENGINEERING

Term 1

Subject	Term Credits	Total Contact Hours Per Week Class	Laboratory
Mathematics	6	6	0
Physics	5	4	3
Chemistry	3	3	0
English	3	3	0
History	3	3	0
Geography	2	2	0
Military	1 2/3	0	5
Physical Training	2	0	6
	25 2/3	21	14

Term 2

Mathematics	5	5	0

1. Annual Register, 1943-44, Pages 81,82.

Physics	5	4	3
Chemistry	4	3	3
English	2	2	0
History	2	2	0
Geography	2	2	0
Military	1 2/3	0	5
Physical Training	2	0	6
	23 2/3	18	17

Term 3

Mathematics	5	5	0
Physics	5	4	3
Engineering Drawing	2	0	6
English	2	2	0
History	2	2	0
Geography	2	2	0
Military	1 2/3	0	5
Physical Training	2	0	6
	21 2/3	15	20

ADVANCED PHASE

CURRICULA 4A1 and 4A 2

CIVIL, ELECTRICAL, AND MECHANICAL ENGINEERING

Term 4 A

Subject	Term Credits	Total Contact Hours Per Week	
		Class	Lab.
Mathematics	10	10	0
Physics	7	5	6
Engineering Drawing	1	0	3
Military	1 2/3	0	5
Physical Training	2	0	6
	21 2/3	15	20

Term 4A was provided for the large number of trainees who were not able to proceed at once with Term 4 of the Advanced Phase Civil, Electrical, and Mechanical Engineering curricula, having been established as refresher instruction for some who had been in practice and as an opportunity for those to make up engineering drawing who had not taken it in college.

ADVANCED PHASE
CURRICULUM CE 1
CIVIL ENGINEERING

Term 4

Subject	Term Credits	Total Contact Hours a week Class	Laboratory
Mathematics	5	5	0
Mechanics	6	6	0
Surveying (Elementary)	3 1/3	2	4
Elements of Electrical Engineering	5 1/3	4	4
Engineering Drawing Structural Drafting	1	0	3
Military	1 2/3	0	5
Physical Training	2	0	6
	24 1/3	17	22

Term 5

Subject	Term Credits	Class	Laboratory
Strength of Materials	4	4	0
Materials Testing Laboratory	1	0	3
Stress Analysis	3	2	3
Fuild Mechanics	4	4	0
Surveying (Advanced)	3	2	3
Internal Combustion Engines	4	3	3
Military	1 2/3	0	5
Physical Training	2	0	6
	22 2/3	15	23

Term 6

Subject	Term Credits	Class	Laboratory
Structural Design	5	4	3
Water Supply and Sewerage	4	3	3
Transportation	4	3	3
Foundations	4	3	3
Engineering Drawing Topographic Drafting	1	0	3
Military	1 2/3	0	5
Physical Training	2	0	6
	21 2/3	13	26

SURVEYING
CURRICULUM AE-S2

Term 4

Subject	Term Credits	Total Contact Hours per Week Class	Laboratory
Mathematics	5	5	0
Plane and Topographic Surveying and Mapping	7 2/3	5	8
Aerial mapping	4 1/3	3	4
Military	1 2/3	0	5
Physical Training	2	0	6
	20 2/3	13	23

The objectives of the curriculum are to give the trainee a working knowledge of the principles and methods of surveying, the use of surveying instruments, topographic mapping, and map construction, compilation and

interpretation, and to prepare the trainee for the application of those principles and methods to the problems involved in artillery complacement and simple firing computations based on military maps and aerial photographs, and to the problems of military engineering."

CURRICULUM SE 1

SANITARY ENGINEERING

Term 7

Subject	Term Credits	Total contact Hours per Week Class	Laboratory
Treatment of Water	4	3	3
Sewage Treatment and Disposal	4	3	3
Hydrology and Drainage	3	3	0
Sanitary Bacteriology	3	2	3
Sanitary Chemistry	3 1/3	2	4
General Sanitation	3	3	0
Military	1 2/3	0	5
Physical Training	2	0	6
	24	16	24

Term 8

Subject	Term Credits	Class	Laboratory
Parisitology	3 1/3	2	4
Sanitary Conference	2	2	0
Advanced Sanitation	4	4	0
Epidemology	3	3	0
Advanced Sanitary Laboratory	3 1/3	2	4
Advanced Sanitary Bacteriology	3 1/3	2	4
Inspection Trip	0 2/3	0	2
Military	1 2/3	0	5
Physical Training	2	0	6
	23 1/3	15	25

The above curriculum was "prepared to provide personnel with some background in sanitary engineering to supervise sanitation and sanitation construction in Army camps."

ADVANCED PHASE
CURRICULUM EE1
ELECTRICAL ENGINEERING

Term 4

Subject	Term Credits	Total Contact Hours per Week Class	Laboratory
Mathematics	5	5	0
Mechanics	6	6	0

Electrical Measurements	2	0	6
Electric and Magnetic Phenomena	6	5	3
Shop Practice	1	0	3
Military	1 2/3	0	5
Physical Training	2	0	6
	23 2/3	16	23

Term 5

Electric Circuits	7	5	6
Engineering Mathematics	3	3	0
Strength of Materials	4	4	0
Materials Testing Laboratory	1	0	3
Direct-Current Machinery	4	3	3
Military	1 2/3	0	5
Physical Training	2	0	6
	22 2/3	15	23

Communications Specialists

Term 6

Electronics and Associated Circuits, Theory and Lab.	7	5	6
Electric Circuits - Transients	3	2	3
Electric Circuits - Distributed Constants	3	3	0
Alternating-Current Machinery	6	5	3
Military	1 2/3	0	5
Physical Training	2	0	6
	22 2/3	15	23

Term 7

High Frequency and Ultra-High Frequency Circuits	8	6	6
Communication Networks	4	3	3
Servo-Mechanism and Control Devices	4	3	3
Radiation and Propagation	3	3	0
Military	1 2/3	0	5
Physical Training	2	0	6
	22 2/3	15	23

Power Specialists

Term 6

Alternating-Current Machinery	5	4	3
Electronics and Associated Circuits, Theory and Laboratory	7	5	6
Electric Circuits - Transients	3	2	3
Thermodynamics	5	5	0
Military	1 2/3	0	5
Physical Training	2	0	6
	23 2/3	16	23

Term 7

Alternating-Current Machinery	5	3	6
Servo-mechanism and Control Devices	4	3	3
Internal Combustion Engines	6	6	0
Internal Combustion Laboratory	1 1/3	0	4
Electric Power Transmission	3	3	0
Military	1 2/3	0	5
Physical Training	2	0	6
	23	15	24

ADVANCED PHASE
CURRICULUM ME 1
MECHANICAL ENGINEERING

Term 4

Subject	Term Credits	Total Contact Hours Per Week	
		Class	Laboratory
Mathematics	5	5	0
Mechanics	6	6	0
Thermodynamics	5	5	0
Engineering Drawing	1 1/3	0	4
Shop Practice	2	0	6
Military	1 2/3	0	5
Physical Training	2	0	6
	23	16	21

Term 5

Strength of Materials	4	4	0
Materials Testing Laboratory	1	0	3
Internal Combustion Engines	6	6	0
Mechanical Laboratory	1	0	3
Kinematics	4	3	3
Metallography and Heat Treatment	4	4	0
Military	1 2/3	0	5
Physical Training	2	0	6
	23 2/3	17	20

Term 6

Mechanical Vibration	3	3	0
Machine Design	5	3	6
Fluid Mechanics	4	4	0
Internal Combustion Engine Laboratory	1 1/3	0	4
Elements of Electrical Engineering	5 1/3	4	4
Military	1 2/3	0	5
Physical Training	2	0	6
	22 1/3	14	25

ADVANCED PHASE
TERM 9A FOR GRADUATE ENGINEERS

Because of differences in preparation, no formal curriculum was provided by the Army for Term 9A to be taken by trainees who had already received their

baccalalaureate degrees in engineering. The Army did specify, however, that the work should include a review of college mathematics through integral calculus, a review of the college work in physics, and a demonstration of the applications of mathematics and physics to engineering problems.

ASTP Enrollments.- As previously stated, the ASTP began here with a total enrollment of about 1,750 trainees for the different phases of work on the Urbana campus. The number reached a peak of around 3,400 in November, 1943, but declined t to a total of about 2,600 in March, 1944. On March 27, however, the quota was reduced to 450 following a sudden announcement by the U.S. War Department of its decision reached during the preceding February to reduce the size of the college training program by three-fourths. Even this number was gradually reduced, for on March 28 there were only 325 and on May 12, 119, practically all of the trainees having left for service duties. The Skating Rink was vacated and the fraternity houses were all turned back to their owners within a few months. No reason was given for this action of the War Department, but it was due, no doubt in part at least, to the inability of the Army to secure its complete quota of men for active duty at the front. In the fall, though, the number was again increased somewhat,-this time to 475,-and in January, 1945, to 700.

The total number of enrollees registered in Engineering in the ASTP for the several terms is indicated in Table XXV. The total for the term beginning on July 12, 1943, was 1,599; on November 8, 1943, 2,089; on February 7, 1944, 1,706; on May 8, 1944, 68; on August 7, 1944, 10; on November 6, 1944,27; and on February 5, 1945, 26. The breakdown is shown to some extent in the table.

TABLE XXV .- REGISTRATION IN ASTP CURRICULA, ENGINEERING, WORLD WAR II

PERIOD	CURRICULA	TERM 1	2	3	4A	4	5	6	7	8	9A	Total
July 12 to October 30 1943	BE	1438	62									1500
	4A											
	CE											
	S											
	SE											
	EE											

baccalaureate degree in engineering. The Army did specify, however, that the work should include a review of college mathematics through integral calculus, a review of the college work in physics, and a demonstration of the application of mathematics and physics to engineering problems.

ASTP Enrollment.- As previously stated, the ASTP began here with a total enrollment of about 1,000 trainees for the different phases of work on the Urbana campus. The number reached a peak of around 1,900 in November, 1943, but declined to a total of about 1,500 in March, 1944. On March 27, however, the quota was reduced to 400 following a sudden announcement by the U.S. War Department of its decision reached during the preceding February to reduce the size of the college training program by three-fourths. Even this number was gradually reduced, for in March of 1944 there were only 300 and on May 31, 115, practically all of the trainees having left for service duties. The [illegible] was vacated and the fraternity houses were all turned back to their owners within a few months. No reason was given for this action of the War Department, but it was due, no doubt in part at least, to the inability of the Army to secure the complete quota of men for active duty at the front. In the Fall, though, the number was again increased somewhat, this time to 425, and in February, 1945, to 700.

The total number of enrollees registered in Engineering in the ASTP for the several terms is indicated in Table XXV. The total for the term beginning on July 19, 1943, was 1,[illegible]; on November 8, 1943, [illegible]; on February 7, 1944, [illegible]; on May 1, 1944, [illegible]; on August 7, 1944, [illegible]; on November 6, 1944, [illegible]; and on February 5, 1945, [illegible]. The breakdown is shown to some extent in the table.

TABLE XXV. - [illegible] IN ASTP (ENGINEERING CURRICULUM), TERMS 1 TO 12

DATES	CURRICULA	TERM 1	2	3	3A	4	5	6	7	8	9	Total
July 19 to October 23, 1943	[illegible]	[illegible]	[illegible]									[illegible]
	[illegible]											
	[illegible]											
	[illegible]											
	[illegible]											
	[illegible]											

PERIOD	CURRICULA	1	2	3	4A	4	5	6	7	8	9A	Total
	ME											
	9A(Grad)										99	99
												1599
November 8	BE	394	1182	177								1753
1943 to	4A(Ce				43							43
January 29	(EE				42							42
1944	(ME				45							45
	CE					39						39
	S											
	SE								26			26
	EE					43						43
	ME					42						42
	9A(Grad)										56	56
	Total											2089
February 7	BE	396	254	590								1240
to	(CE				11							11
April 29	4A(EE				6							6
1944	(Me				48							48
	CE						26					26
	AE-S		26	22		30						78
	SE								34	29		63
	EE					76	32	28				136
	ME					27	34					61
	9A(Grad)										37	37
	Total											1706
May 8 to	BE	15	24									39
July 29,	SE									29		29
1944	Total											68
August 7 to	BE			10								10
October 28,												
1944	Total											10
November 6												
1944 to	SE								27			27
January 27												
1945	Total											27
February 5 to	SE									26		26
April 28,1945	Total											26

Navy Training Programs.- Several training programs carried on under authority of the U. S. Navy, ~~have been~~ were in effect at the University during World War II. These are described briefly in the following sections.

School for Navy Signalmen.- In May, 1942, about 800 men were assigned to the University as trainees for the School of Navy Signalmen. They were housed in the Men's Old Gymnasium and the Gymnasium Annex, - the Annex having been enlarged to some extent to make provision for them,-and were messed in the Illini Union Ball

Room. Some time later, the number was increased to 900 and still later to 1,000, and was maintained at that level until the summer of 1944, after which the enrollment was gradually reduced until the school was discontinued in October of that year. The length of the instructional period for each contingent was sexteen weeks. Since the Navy provided its own instructional staff, and no part of the work was administered by the College of Engineering, the details of their training program are not included here. The enrollees did, however, use some of the engineering buildings for recitation purposes.

School for Diesel-Engine Operators.- In July, 1942, there was begun a School for Diesel-Engine Operators that continued through eight-week terms until October, 1944. The training exercises were all conducted in a special laboratory set up for the purpose in West Hall of the Memorial Stadium. The details of instruction are not included here because the work was all administered by Navy personnel. The School had a quota of about 700 enrollees, and operated with approximately that number from the beginning. The five units of the Men's Residence Halls were taken over to provide housing and messing facilities for the trainees.

School for Diesel-Engine Officers.- A course entitled "Theory and Practice of Diesel-Engine Operation" was given from September 14, 1942, to February 13, 1943, under the ESMWT program administered by the University Extension Division. Some details of the plan for training the 450 enrolled officers in three classes are given under Engineering Extension in Chapter XXIV.

V-I, V-5, and V-7 College Programs.- Students enlisted as reservists in the V-I Class, those in the V-5 class in aviation, and those in the V-7 class taking engineering training were allowed to continue here at the University for a time in their respective classroom commitments until they were placed on active duty as apprentice seamen, at which time they were transferred to the V - 12 classification to continue in an accelerated program until they had completed their college training.

Room. Some time later, the number was increased to 500 and still later to 1,000, and was maintained at that level until the summer of 1944, after which the enrollment was gradually reduced until the school was discontinued in October of that year. The length of the instructional period for each contingent was sixteen weeks. Since the Navy provided its own instructional staff, and no part of the work was administered by the College of Engineering, the details of their training program are not included here. The enrollees did, however, use some of the engineering buildings for recitation purposes.

School for Diesel-Engine Operators.- In July, 1942, there was begun a School for Diesel-Engine Operators that continued through eighteen terms until October, 1944. The training exercises were all conducted in a special laboratory set up for the purpose in West Hall of the Memorial Stadium. The details of instruction are not included here because the work was all administered by Navy personnel. The School had a quota of about 150 enrollees, and operated with approximately that number from the beginning. The five units of the Men's Residence Halls were taken over to provide housing and messing facilities for the enrollees.

School for Diesel-Engine Officers.- A course entitled "Theory and Practice of Diesel-Engine Operation" was given from September 14, 1942, to February 13, 1943, under the University ESMWT program distributed by the Extension Division. Some details of the plan for training the 148 enrolled officers in three classes are given under Engineering Extension in Chapter XXIV.

V-1, V-5, and V-7 College Programs.- Students enrolled as reservists in the V-1 Class, those in the V-5 class in aviation, and those in the V-7 class taking engineering training were allowed to continue here at the University for a time in their respective classroom programs until they were placed on active duty in appropriate centers, at which time they were transferred to the V - 12 classification to continue in an accelerated program until they had completed their college training.

Training Program V-12.- The purpose of the Navy College Training Program, V-12, was "to prepare officer material for the various branches of the Naval, Marine, and Coast Guard services, including aviation cadets, engineer and deck officers, engineer specialists, medical and dental officers, supply Corps officers."

Like the ASTP in the Army, candidates were selected by the Navy officers and not through the usual University channels. As one means for accomplishing this end , there was scheduled for April 2, 1943, a nation-wide competitive examination by the Army and Navy on a voluntary basis for men graduates of high schools and preparatory schools of the country. Of the 316,000 men taking the examination and from the 123,000 of whom expressed their preference for the Navy, 17,000 were selected for the class beginning about July 1, 1943. In addition, 10,000 men selected by their commanding officers from highschool graduates already enlisted in the Nayy, were assigned to the V-12 program. Furthermore, those students grouped in the V-1, V-5, and V-7 classification were transferred to the V-12 class. Of all these groups, a quota of 450 was assigned to the University of Illinois for their training programs. This number was later reduced so that by the end of 1944, there were 336 enrolled here. These men under U. S. Navy discipline, were housed and messed in the men's and women's residence halls on the campus,[1] under terms of lease from the Navy, and were instructed by members of the University staff. Within the limits of their available time, they were allowed to participate in extra-curricular activities including college athletics, on the same basis as civilian students. These men were not only provided by the Government with room and study facilities including books and equipment, meals, and uniforms, but also were given $50 a month pay. The length of time the trainees remained here was determined by their curricula which were prescribed by the Navy and based on the amount of previous training on the College level.

1. After November 15, 1944, these men were all housed in the Men's Residence Halls and the Women's halls were returned to the University.

<u>Training Program V-12.</u>-- The purpose of the Navy College Training Program, V-12, was "to prepare officer material for the various branches of the Naval, Marine, and Coast Guard services, including aviation cadets, engineer and deck officers, engineer specialists, medical and dental officers, supply corps officers."

Like the ASTP in the Army, candidates were selected by the Navy officers and not through the usual University channels. As one means for accomplishing this end, there was scheduled for April 2, 1943, a nationwide competitive examination in the Army and Navy on a voluntary basis for new graduates of high schools and preparatory schools of the country. Of the 316,000 men taking the examination and from the 100,000 of whom expressed their preference for the Navy, 17,000 were selected for the first beginning class July 1, 1943. In addition, 10,000 men selected by their commanding officers from high-ranking graduates already enlisted in the Navy, were assigned to the V-12 program. Furthermore, those students enrolled in the V-1, V-5, and V-7 classification were transferred to the V-12 class. Of all these groups, a quota of 840 was assigned to the University of Illinois for their training program. This number was later reduced so that by the end of 1944, there were 319 enrolled here. These men under U. S. Navy discipline, were housed and messed in the men's and women's residence halls on the campus,[1] under terms of lease from the Navy, and were instructed by members of the University staff. Within the limits of their available time, they were allowed to participate in extra-curricular activities including college athletics, on the same basis as civilian students. These men were not only provided by the Government with room and study facilities including books and equipment, meals, and uniforms, but they were given $50 a month pay. The length of time the trainees remained here was determined by their curricula which were prescribed by the Navy and based on the <u>amount of previous</u> training at the College level.

1. After December 15, 1943, these men were all housed in the Men's Residence Halls and the Women's halls were returned to the University.

V-12 Curricula.- Curricula assigned to the University of Illinois included programs for aviation cadets; civil engineer corps; engineer specialists relating to steam and internal-combustion engines, electric power and electric communication; and medical and dental students. The curriculum for aviation cadets was only two terms in length; that for the others was eight terms,- each term being sixteen weeks in length. The text-books used were those ordinarily prescribed in civilian courses of the same content, the instructional work being given by members of the University staff. The usual number of quizzes and a final examination were given to aid the instructors in making up the term grades. University credit was given the same as in civilian training to those who passed their courses.

These curricular programs are outlined on the following pages. These curricula for medical and dental students are not included because the College of Engineering had no responsibility for their administration. The one in electric communication is omitted also, because there were no students assigned to it.

A - V (N) AVIATION CANDIDATES

FIRST COLLEGE YEAR

Subject	Periods per Week[1] 1st Term		2nd Term	
Mathematical Analysis I or III, II or IV	5	(5)	5	(5)
English I-II	3	(3)	3	(3)
Historical Background of Present World War I-II	2	(2)	2	(2)
Physics I-II	4	(6)	4	(6)
Engineering Drawing and Descriptive Geom.	2	(6)	2	(6)
Naval Organization I-II	1	(1)	1	(1)
	17	(23)	17	(23)
Physical Training	2	(6)	2	(6)
	19	(29)	19	(29)

1. Figures in paranthesis indicate the contact hours per week in classroom and laboratory. Figures outside of paranthesis indicate the number of meetings per week in classroom and laboratory.

Civil Engineering. Curricula designed at the University of Illinois included programs for training civil engineers, sanitary engineers, specialists relating to steam and internal-combustion engines, electric power and electric communications and medical and dental students. The curriculum for civilian cadets was only two terms in length; that for the others was eight terms, each term being thirteen weeks in length. The instruction each term, where ordinarily prescribed by official courses of the same content, the instructional work being given by members of the University staff. The usual system of grades and a final examination were given in all the instruction [illegible] as the term grades. University credit was given the same as in civilian training to those who passed these courses.

These curricular programs are outlined on the following pages. Those curricula for medical and dental students are not included because the College of Engineering had no responsibility for their administration. The one in electric communications is omitted also, because there were no students assigned to it.

A - V (S) - CIVILIAN ENGINEERING

FIRST (BASIC) TERM

Subject	Periods per week[1] 1st Term	2nd Term
Mathematical Analysis I or III, II or IV	[illegible]	[illegible]
English I-II	[illegible]	[illegible]
Historical Background of Present World War I-II	[illegible]	[illegible]
Physics I-II	[illegible]	[illegible]
Engineering Drawing and Descriptive Geom.	[illegible]	[illegible]
Naval Organization I-II	[illegible]	[illegible]
	[illegible]	[illegible]
Physical Training	[illegible]	[illegible]
	[illegible]	[illegible]

1. Figures in parentheses indicate the contact hours per week in classroom and laboratory. Figures outside of parenthesis indicate the number of credits for work in classroom and laboratory.

CEC-V(S) CIVIL ENGINEER CORPS CANDIDATES

FIRST COLLEGE YEAR

(Same as Aviation Candidates)

SECOND COLLEGE YEAR

Subject	Periods per week 3rd Term		4th Term	
Calculus I, II	4	(4)	4	(4)
Chemistry Ia-IIa and Engineering Materials	4	(6)	4	(6)
Analytical Mechanics			5	(5)
Surveying - Plane and Geodetic	3	(7)	5	(11)
Naval History and Elementary Strategy	3	(3)		
Psychology I - General	3	(3)		
	17	(23)	18	(26)
Physical Training	2	(6)	2	(6)
	19	(29)	20	(32)

THIRD COLLEGE YEAR

Subject	5th Term		6th Term	
Thermodynamics Ia and Heat Power Ia	3	(3)	3	(5)
Electrical Engineering I, II	3	(5)	3	(5)
Strength of Materials I	3	(3)		
Materials Laboratory I			3	(7)
Fluid Mechanics			3	(5)
Curves and Earthwork	3	(5)		
Structures I, II, III	5	(7)	6	(10)
	17	(23)	18	(32)
Physical Training	2	(6)	2	(6)
	19	(29)	20	(38)

Fourth College Year

Subject	Periods per Week 7th Term		8th Term	
Structures Iv, V	5	(9)	5	(9)
Sanitary Engineering			3	(5)
Water Supply	3	(5)		
Contracts and Specifications			2	(2)
Soil Mechanics	3	(5)		
Technical Reports	2	(2)		
Airport Design			3	(5)
Industrial Organization			3	(3)
Highway Engineering	4	(6)		
Economics of Engineering I, II	2	(2)	2	(2)
	19	(29)	18	(26)
Physical Training	2	(6)	2	(6)
	21	(35)	20	(32)

E - V(S), A - V(S), O - V(S) Engineer Specialist Candidates

Mechanical - Steam and Internal Combustion Engines

FIRST COLLEGE YEAR

(See Aviation Candidates)

SECOND COLLEGE YEAR

Subject	Periods per week 3rd Term		4th Term	
Calculus I, II	4	(4)	4	(4)
Chemistry Ia- IIa, and Engineering Materials	4	(6)	4	(6)
Analytical Mechanics I, II			5	(5)
Economics I-II, Principles of	3	(3)	3	(3)
Naval History and Elementary Strategy	3	(3)		
Kinematics			2	(4)
Psychology I	3	(3)		
	17	(19)	18	(22)
Physical Education	2	(6)	2	(6)
	19	(25)	20	(28)

THIRD COLLEGE YEAR

Subject	5th Term		6th Term	
Thermodynamics I and Heat Power	5	(5)	5	(9)
Electrical Engineering I, II	4	(6)	4	(6)
Strength of Materials I	3	(3)		
Materials Laboratory I			3	(7)
Machine Design	3	(5)		
Fluid Mechanics			3	(5)
Mechanical Processes	3	(3)		
Mechanics of Machinery			3	(5)
	18	(22)	18	(32)
Physical Training	2	(6)	2	(6)
	20	(28)	20	(38)

FOURTH COLLEGE YEAR

Subject	7th Term		8th Term	
Heat Power II, III	5	(9)	5	(9)
Naval Machinery	2	(4)		
Metallurgy	3	(5)		
Industrial Organization	3	(3)		
Aerodynamics			3	(3)
Refrigeration			3	(5)
Mechanical Design I, II	3	(5)	3	(5)
Electron Tubes and Circuits Ia-IIa	2	(4)	2	(4)
Contracts and Specifications			2	(2)
	18	(30)	18	(28)
Physical Training	2	(6)	2	(6)
	20	(36)	20	(34)

E - V(S), A - V(S), O - V(S) ENGINEER SPECIALIST CANDIDATES

Electrical - Power

FIRST COLLEGE YEAR

(See Aviation Candidates)

SECOND COLLEGE YEAR

Subject	Periods per week 3rd Term		4th Term	
Calculus I, II, III	4	(4)	6	(6)
Chemistry Ia-IIa, and Engineering Materials	4	(6)	4	(6)
Analytical Mechanics I, II			5	(5)
Economics I-II, Principles of	3	(3)	3	(3)
Naval History and Elementary Strategy	3	(3)		
Electricity and Magnetism	3	(5)		
	17	(21)	18	(20)
Physical Training	2	(6)	2	(6)
	19	(27)	20	(26)

THIRD COLLEGE YEAR

	5th Term		6th Term	
Electric and Magnetic Circuits I-II	5	(9)	5	(9)
D. C. Machinery and Storage Batteries I			5	(9)
Thermodynamics Ia and Heat Power Ia	3	(3)	3	(5)
Strength of Materials I	3	(3)		
Materials Laboratory Ia			2	(4)
Kinematics	2	(4)		
Fluid Mechanics			3	(5)
Electrical Measurements	5	(9)		
	18	(28)	18	(32)
Physical Training	2	(6)	2	(6)
	20	(34)	20	(38)

FOURTH COLLEGE YEAR

	7th Term		8th Term	
Elective			3	(3)
Electron Tubes and Circuits I-II	2	(4)	4	(6)
Alternating-Current Machinery I	5	(7)		
Electrical Design I			3	(7)
Electrical Engineering Laboratory			3	(5)
Naval Machinery			2	(4)
Contracts and Specifications	2	(2)		
Psychology I - General	3	(3)		
Industrial Organization			3	(3)
Mechanical Processes	3	(3)		
Machine Design	3	(5)		
	18	(24)	18	(28)
Physical Training	2	(6)	2	(6)
	20	(30)	20	(34)

V-12 Enrollments.- The total registration of V-12 students in the different curricula for the several terms is shown in Table XXVI. For the term beginning on July 2, 1943, it was 437; on October 29, 1943, 413; on March 3, 1944, 420; on July 3 1944, 427; on November 2, 1944, 323; on March 2, 1945, 292; and on July 2, 1945, 222. The breakdown of figures is shown to some extent in the table.

TABLE XXVI - REGISTRATION IN V-12 CURRICULA, ENGINEERING, WORLD WAR II

PERIOD	CURRICULUM	Terms 1-3, incl. 1	2	3	TERMS 4-8 inclusive: Aero A.E. Eng.	Ch.E	Cer. Eng.	CE	EE	GE	ME	Min. and Met	Phys.	Total
July 2 to October 23: 1943	Av. Cad.													
	CE													
	ME													
	EE													
	Adv[1]													
	Total													437
November 1: 1943 to February 26, 1944	Av. Cad	44	90											134
	CE													
	ME													
	EE													
	Adv.													279
	Total													413
March 6 to: June 24, 1944	Av. Cad	58	55											113
	CE			25										25
	ME			33										33
	EE			29										29
	Adv.													220
	Total													420
July 3 to : October 25: 1944	Av Cad	12	61											73
	CE			6										6
	ME			12										12
	EE			28										28
	Adv					38	8	64	66	9	91	9	23	308
	Total													427
November 2: 1944 to February 21, 1945	Av. Cad	3	12											15
	CE			22										22
	ME			17										17
	EE			9										9
	Adv.				1	27	2	65	77	6	60	1	21	260
	Total													323
March 2 to: June 20 1945	Av. Cad	10	1											11
	EE			1										1
	ME			2										2
	Adv				1	22	2	88	71	3	71	1	19	278
	Total													292
July 2 to : October 20: 1945	NROTC	1	2	9	←			34	→					46
	Adv.[2]				1	9		70	47		45		4	176
	Total													222

1. Those Enrolled beyond Term 3
2. Those Enrolled beyond Term 5

After the war, the V-12 program was discontinued and in its place was substituted the Naval Reserve Officers' Training Corps curriculum. The change was made on July 1, 1945, although the program was not officially installed until November 1 following. One hundred thirty seven new trainees, one hundred twenty-nine having been sent here from other stations and eight from the local naval unit, and one hundred sixty-three V-12 men were enrolled in this new curriculum. This curriculum is described in a later chapter.

<u>War-Time Extension Service in Engineering Education.-</u> In the early part of World War II, an instructional program designated as Engineering, Science, and Management War Training was inaugurated at the University which became a prominent factor in wartime education for workers not enrolled in Campus courses. The following statement concerning this work is taken from the 1943-44 issue of the Annual Register:[1]

"To help the industries of Illinois in meeting their urgent need for trained workers, extramural courses in many phases of engineering, science, and management are conducted by the University of Illinois in cooperation with the United States Office of Education. These courses, now being given in 54 different communities of the state, are taught by faculty members drawn chiefly from the College of Engineering and by qualified engineers or other specialists in the industries. Their purpose is to prepare men and women for new positions in the war industries and to give additional training to those already employed in such work. The total enrollment in these courses is now close to seventeen thousand."

This program is described in some detail at the end of the next chapter which is entitled University Extension in Engineering.

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1. Page 80

CHAPTER XXIV

UNIVERSITY EXTENSION IN ENGINEERING

General.- Since 1914, the University of Illinois has given attention to engineering-extension activities and services that have included conferences and short courses, institutes, correspondence courses, extramural courses, defense training, visual instruction, and so on. These are, in part, described in the remainder of this chapter.

A. ENGINEERING CONFERENCES AND SHORT COURSES

General.- The College of Engineering in common with other colleges of the University has sought to extend its services to the public by offering on the campus short courses of instruction most of which are open to all interested without fee or educational restriction. Some of these are described in some detail below.

This feature of College activity is concerned, for the most part, with adults who hold more or less responsible positions in some phase of industrial enterprise in their several communities. The scheduled programs for the various sessions, which may last from one day to two weeks in length, included lectures on specific topics, discussions and conferences on individual and special problems, and laboratory exercises of peculiar interest to the particular group at hand. In addition to the educational value these meetings afford, they provide splendid opportunities for acquaintanceship among those engaged in a common industry. There is little doubt but that the exchange of experience and opinion that takes place at such meetings between individuals and groups outside the scheduled periods, is worth as much as, and possibly more than, the knowledge gained from the formal programs.

Highway Short Course.- The first short course sponsored by the College of Engineering was the two-weeks' session in Highway Engineering held at the University from January 19 to January 31, 1914, under the auspices of the Department of Civil Engineering, in cooperation with the State Division of Highways. The occasion for this innovation was the fact that during the preceding year the General Assembly had passed the Tice Law completely reorganizing the care and

maintenance of the state-aid system of financing the construction of highways of the State, reorganizing the State Highway Department, and providing for the appointment of a superintendent of highways for each county to have charge of the road work in that county,- the beginning of an organized and comprehensive system of hard-surface road improvement in the State of Illinois. The University thought the proposed short course might be helpful in preparing these county officials for their new duties. At the first meeting, there were registered 63 of the 66 county superintendents then appointed; and the total attendance was 191 including many other engineers and contractors. A large and instructive exhibit of roadmaking machinery was assembled in the Armory, and much of this equipment was operated practically, either in the Armory or on the adjacent streets.

Almost as soon as it was ready to begin, the Short Course in 1915 was abandoned at the request of the State Highway Commission on account of the epidemic of the foot and mouth disease then prevailing among the cattle of the State. The second Short Course was held during January 10-22, 1916. After 1917 the meetings were only a week in length. In 1920, when the entire state corps of the State Division of Highway was required to attend, the registration reached 601. The sessions were held in the Wesley Foundation and Thomas McDonald, Chief of the Bureau of Good Roads of the Department of Agriculture in Washington, D.C., gave the principal address. At the twelfthHighway Short Course held February 16-20, 1925, Governor Len Small gave a public address in the University Auditorium. The opening meeting of the Short Course in 1928 was also held in the Auditorium' when Governor Small again addressed the assembly,- there being about 1,500 persons present on that occasion. The registration for that Short Course held February 22-24, was 509 made up as follows:

County and Township representatives	150
State Highway Department and State officers	124
University Faculty	118
Contractors and materials dealers	47
Unclassified	70
Total	509

This list does not include students registered in the University. This number had never been exceeded any year except in 1920 when the attendance reached the 601 previously stated.

There was no Short Course scheduled for 1933 on account of changes in the personnel of the Highway Department at Springfield and on account of the uncertainties and the financial situation. That was the only omission between 1916 and 1935.

From the beginning of these short courses, the Department of Civil Engineering had the fullest and most cordial cooperation of the State Highway Commission and its successor, the Division of Highways of the State Department of Public Works.

From the first, the character of the programs varied from time to time to meet the ever-changing conditions of road building and administration in the State. Throughout the years, the object was to provide an opportunity for the highway builders and administrators of the State to get together for mutual acquaintance, to discuss the many problems that confronted them, and to gain the latest and best information pertinent to their work. The results demonstrated the value of the meetings, not only to those attending, but also to the communities or interests they represented.

The subjects considered at the short courses included highway-system planning, taxation, motor-vehicle licenses, policing, safety, road surfaces, foundations and foundation soils, roadside development, methods of handling snow, highway structures, highway-research problems, traffic surveys, road laws, and so on.

Except for the few occasions previously mentioned, the sessions were held in the assembly room, 219 Engineering Hall, until 1929, when the Electrical Engineering Assembly room was completed. After that time, the general meetings were held in it. Professor C C. Wiley was in direct charge of the programs for the Department of Civil Engineering here. The attendance averaged well over 300. No. fee of any kind was charged for those registering for these short courses. Beginning in 1936 the nature of the work was changed somewhat as described in the next article.

Conference on Highway Engineering.-The present name, Conference on Highway Engineerring, was adopted in 1935; and since that time, the programs have been only three days in length. Conferences have been held each year except 1945 when no meeting was scheduled because of an order from the Director of War Mobilization banning such gatherings in view of war-time transportation and other economic conditions. The sessions have been held as formerly, in the latter part of February or early March, under the auspices of the Department of Civil Engineering in cooperation with the Illinois Division of Highways and the Illinois Association of County Superintendents of Highways. The conferences have been open without fee to anyone interested in any way in the improvement of roads and streets in the State. The normal attendance has consisted of state, county, city, and local engineers and officials; road and street contractors; material and equipment dealers; and University instructors and students.

Professor C. C. Wiley has represented the interests of the University in preparing the programs and directing the meetings as he did for the short courses previously given. The general meetings have been held in the Electrical Engineering Assembly with attendance averaging well over 400. Analysis of representation for 1937 and 1938 is given below:

Highway Conference Attendance	1937	1938
Illinois Division of Highways	134	139
County Superintendents of Highways	67	67
County and Township Officers	60	69
City Engineers and Officials	10	26
Contractors and material men	92	98
Faculty	12	19
Students	46	49
Miscellaneous	25	34
Total	446	501

Illinois Traffic Engineering Conference.- An Illinois Traffic Engineering Conference was held during February 11-14, 1941, having been sponsored by the Department of Civil Engineering and the Illinois Division of Highways,-Professor C. C. Wiley representing the interests of the University. The program was a schedule of lectures from 8:30 a.m. to 4:30 p.m. each day, with meetings held in 215 Electrical Engineering

Building,-the large lecture room in that building. The Conference, the first of its kind ever to be held in this country, was designed to provide a comprehensive review of the latest traffic-engineering techniques and results, to permit the exchange of ideas and methods, and to aid engineers interested in traffic engineering to become acquainted with one another and with national leaders in the traffic-engineering field.

The subjects included traffic surveys, traffic and national defense, legal aspects of traffic control, application of signs and markings, railroad grade-crossing protection, human behavior and limitations, vehicle behavior and limitations, Illinois highway design principles, speed and speed control, the parking problem, street-intersection design, and so on.

One hundred-seven persons registered for the meetings.

Surveying Conference.- A two-day Surveying Conference was first scheduled for March 4 and 5, 1938: and similar conferences were held during the next four years under the auspics of the Department of Civil Engineering, with Professor W. H. Rayner in immediate charge, and the Illinois Society of Engineers,- coming at the end of the same week as the Highway Conference. The attendance ran from 75 to 100 registrants. The subjects considered at these sessions were those commonly dealt with in plane and higher surveying, including, among others, surveyors' license laws land surveying, aerial surveying, survey controls, stream gaging and hydrographic surveying, the land surveyor's library, and legal aspects of surveyors' plats.

Drainage Conference.- Three drainage Conferences, the first one on March 8-11, 1916, the second one on March 13-15, 1917, and the third one on March 16-18, 1920, were held at the University under the auspices of the Department of Civil Engineering, with Professor F. H. Newell, Head of the Department, in charge. About 50 persons including engineers, drainage officials, contractors, sanitarians, economists, and public officials from Illinois and neighboring states, attended the sessions. The main subjects considered at these conferences included drainage surveys, watersheds, the engineering features of drainge, the maintenance of

~~drainage works, excavating machinery~~

drainage works, excavating machinery, the economics of drainage, drainage laws, flood control, bond issues for drainage districts, and levee construction,

Short Course for Firemen.- The short course on Fire Prevention, Control, and Extinguishment was first given at the University during June 16-19, 1925. While this was not a departmental affair, Professor L. H. Provine, Head of the Department of Architecture, was chairman of the general committee in charge of the program and Professor C. E. Palmer, was director of the short course. Two hundred-nineteen were registered for the work. Splendid cooperation was received through the State Fire Marshall's office and through the Illinois Firemen's Association. An interesting program including demonstrations, was given by men well qualified to handle the assigned topics. Similar short courses have been held in June of each year since that time. An appropriation of $8,000 was made by the General Assembly for the construction of a training tower to be used in connection with the short course. The tower was erected in the spring of 1928 on the east side of Sixth Street in Champaign immediately south of the Short Line railroad tracks and used in the Short Course in June and other years following.

Illinois Miners' and Mechanics' Institutes.- The work of these Institutes was described under this same heading in the chapter on Mining Engineering and Metallurgy and is not repeated here.

Congress on Labor Problems.- A Congress on Labor Problems Resulting from World War I, was held at the University on Febraury 14-16, 1918. The meetings, held under the auspices of the Department of Mining Engineering in cooperation with the Illinois Manufacturers' Association, the Illinois Coal Operators' Association, and th the State Federation of Labor, were addressed by some of the foremost representatives of employers and labor in this section of the country on various phases of problems involving the human factor in industry. The list of speakers included Miss Agnes Nestor of the Woman's Trade Union League; J. W. Dietz, Educational Director of the Western Electric Company; Victor Olander, Secretary of the Illinois State Federation of Labor; Charles Piez, President of the Link Belt Company; John P. Frey, Editor of the International Iron Moulders Journal; G. C. Farnum, Industrial

Physician of the Avery Company of Peoria; Frank Ferrington, President of the Illinois District of the United Mine Workers; R. C. Richards of "Safety First" fame; and Mathew Woll, President of the International Photo-Engravers Union. This series of meetings was beneficial not only to the engineers, but also to other groups on the campus as well.

Short Course on Coal Utilization.- The Short Course on Coal Utilization was held for the first time on July 11-13, 1934, under the auspices of the Department of Mining and Metallurgical Engineering. It was offered for the purpose of presenting "an educational program of technical and practical information pertaining to coal and its efficient utiliaation for the benefit of those engaged in the mining, preparing, marketing, and using of coal, and of those interested in the manufacture and distribution of machinery used in the preparation and utilization of coal." Other sessions were held during July 11-13, 1935; June 9-11, 1936; May 25-27, 1937; May 23-25, 1939; and May 21-23, 1941. The list of attendances, representing registrants from as many as eighteen different states, varied from 150 to 325,-those attending the second short course for instance being classified as follows:

Retailers and Retail Salesman	54
Wholesalers and Wholesale Salesmen	66
Coal Operators and Officials	16
Fuel Engineers, Coal Services, etc.	23
Stoker Manufacturers and Salesmen	23
Other Equipment Manufacturers and Salesmen	13
Plant Engineers	3
Association Men	4
Educational and Press	22
Miscellaneous	8
Total	232

The subjects considered at these meetings included coal analysis, boiler tests, coal preparation, stokers and stoker coal, heating values, heating loss, ash, heating plants, heating equipment, air conditioning, control systems, the marketing of coal, smoke elimination, coal sizing, and so on.

The programs were under the direction of Professor A. C. Callen, H. L. Walker, D. R. Mitchell, and H. P. Nicholson.

<u>Electric Metermen's Short Course</u>.- In the spring of 1920, the Illinois Electric Association suggested that a two weeks' course for metermen be given by the University for such employees of the electrical utility companies of the State as might be sent to take instruction. The association offered to pay the full expenses incurred by the University on account of the course.

Due to the lack of facilities and room, the period set for the course was for Monday, June 21, following Commencement in 1920. The work was placed under the direction of Mr. A. R. Knight, who was assisted by Professor E. H. Waldo and Mr. E. A. Reid. The courses were two weeks long. Nineteen representatives were present from the manufacturers and users of electrical equipment throughout the country to give instruction. Thirty-four students registered during the first week and forty-four during the second. These students were employed by twenty-~~thr~~ three electrical utility companies scattered over the State. These men stayed in College Hall,- a large student rooming house, privately owned, near the campus. This gave them a better opportunity to become well acquainted and to discuss their common problems.

Lectures followed by three-hour laboratory periods were ~~were~~ given at 8 a.m. and at 1.p.m. The instruction during the first week was devoted largely to fundamental principles and to direct-current meters. That during the second week was on alternating-current meters and to the more advanced problems of polyphase metering. At 7 o'clock each evening, the group assembled for lectures by the experts from the manufacturing companies.

One result of the meetings or conferences was the organization of the Illinois Electrical Meterman's Association. The aim of the Association was to give an opportunity for the members to become better informed concerning the technical problems connected with their work.

Similar courses, although only a week in length, were held from June 13 to 18, 1921; June 11 to 16, 1923; and June 9 to 14, 1924, at which the attendance varied between 40 and 50 registrants.

Some changes in methods of procedure were developed for the short course given during the week of June 16 to 20, 1925. Instruction was arranged for two groups: Group A, for men having little experience in meter work; and Group B, for more advanced men. Members of Group A spent most of their time in gaining a knowledge of the principles, construction, and testing of watthour meters. Those of Group B attended laboratory demonstrations which were followed by thorough discussions of the observed behavior of meters, rather than by the method of individual experiments, used in previous years. For this course, the emphasis was placed on the science ~~rather~~ rather than the art of metering. Eight students registered for Group A course and 57 for Group B course.

Similar courses were given during 1927, 1928, 1929, with about 15 students registering for the Group A meetings and about 55 for the Group B sessions.

Beginning in 1930, the short course was given in cooperation with the leading power companies of the State. In the ninth short course, held from June 9 to 14, 1930, instruction was arranged for two courses, Course I dealing with the principles of direct-current and single-phase circuits and metering, and Course II, with polyphase circuits and metering. Because of the increasing use of the power factor in making rates, more time was devoted to methods of metering reactive volt amperes than in the past. An optional course dealing with protective relays was offered during the lasttwo days. A total of 58 students was registered, of whom 24 took Course I and 34 Course II. Nineteen students in Course II selected the relay option.

The tenth short course,-the last of its kind,- was held June 15-20, 1931, with 15 registrants in Course I and 46 in CourseII.

Electric Metermen 's Conference.- After a lapse of several years during the depression in which there were no short courses, it was decided to undertake the work again, but on a different basis. Accordingly, on April 19-21, 1939, an Electric Metermen's Conference, as it was called, was held in cooperation with several power companies in the State. The previous meetings were held during vacation periods, but it seemed advisable to change the time and schedule the Conference at a date when the University was in regular session, because there was

little chance of getting outside financial aid, as was formerly possible, to compensate the members of the staff taking part in the instructional work. A registration fee of $2 was changed each person attending to cover some of the incidental expenses connected with the Conference. The program included lectures, discussions, movies, etc. The total attendance was 84. No conferences have been held, however, since 1939.

Short Course in Plumbing, Heating, and Hydraulics.- On February 1-3, 1923, a Short Course in Plumbing, Heating, and Hydraulics was given by a combination of the departments of Mechanical Engineering, Municipal and Sanitary Engineering, and Theoretical and Applied Mechanics of the University, and the State Water Survey Division. There were 102 persons registered for the meeting, mostly master plumbers, with some steam fitters, from all sections of the State. The work included lectures, demonstrations of the action of plumbing equipment under various conditions, and experimental illustrations in the Hydraulics Laboratory and at the experimental Sewage Treatment Plant. A second course was given during January 31- Eebruary 2, 1924, with an attendance of 201.

Sewage Treatment Works Operators' Short Course.- The Sewage Treatment Works Operators' Short Course, sponsored by the State Department of Public Health and the Department of Civil Engineering, was first offered during March 6-11, 1939. The purpose of the course was to instruct inexperienced operators of the many sewage-treatment plants being installed in the State. As much of the work of instruction required laboratory facilities for demonstration and practice, attendance at the course was restricted to the available laboratory equipment on hand in room 113 Talbot Laboratory and the new Sanitary Engineering Laboratory.

During this first course, instruction was conducted through a series of lectures each morning from 8 o'clock until noon. From 1 to 2 p.m. the period was devoted to the general discussion in the presence of the lecturers of the morning. The remainder of the day until 5 p.m. was spent in the laboratory under instruction by a member of the State Department of Health.

The course was financed by the payment of a matriculation fee of $10 by each registrant. This money was used in the purchase of books for these men and to defray, in part, the expenses of the lecturers.

A second course was held about the same time in 1941, and others have been held each year since then,[1] , the enrollment being limited to 16 in each ease. The subjects discussed included general duties of sewage-treatment works' operators, characteristics of sewage, natural purification in streams, operation of screens and grit chambers, sodimentation units, and use of chemicals in sewage disposal.

Professor H. E. Babbitt has represented the University in the conduct of these short courses.

Water-Treatment Plant Operators' Short Course.- The Water-Treatment Plant Operators' Short Course was held for the first time on March 4-8, 1940, and has been repeated in March, each year since. It has been held under the auspices of the Department of Civil Engineering, with Professor H. E. Babbitt in charge, in cooperation with the State Department of Health. The purpose of the course has been to present information covering some fundamentals in chemical and bacteriological control with an explanation of some principles and practices in water-treatment plant operation.

The course has been conducted as a series of lectures given during the morning hours, followed by a period of discussion, and a daily three-hour period in the laaoratory inthe afternoon. A registration fee of $7.50 has been charged to cover a portion of the cost of the instruction.

The subjects considered at these five-day meetings have included sanitation, purposes and problems in water treatment, care of distribution systems, geology of raw waters, taste and odor control, chemistry of water treatment, care of filters, water softening, sterilization of water supplies, corrosion control, etc.

Registration has been restricted to those for whom reservations have been made through the State Department of Health, and has been limited to 16. The

1. Since 1943, all of the facilities have been housed in the new Sanitary Engineering Laboratory Building.

lecturers have been secured from among members of the University staff, personnel of the State Department of Public Health, and various persons outstanding in waterworks practice.

Ceramics Short Course.- The Ceramics Short Course for clay workers was begun in 1912 while the work in ceramics was still being administered in the College of Science. The motive prompting the organization of such a course was the desire to serve the interests of the clay workers of the State who had so enthusiastically and persistently urged the need for the establishment of such a department. The course lasted two weeks and was given in January of each year until 1916, when the Department was taken over by the College of Engineering. After that, a short course involving clay working and enameling was held every two years, either in January or February, until 1934. This also attracted wide attention from men interested in the ceramic industries. The attendance, varying from 50 to 70, and coming from ten or twelve different states, was made up of men from brick, glass, enamels, pottery, and other phases of the industry, and consisted of proprietors, superintendents, foremen, technical-school graduates, college graduates, and men with only a secondary education. No fees were assessed until 1934, when a charge of $7. was made to make the course self-supporting. The instruction consisted of lectures followed by laboratory work, such as practice in the firing of the kilns and the testing of clay samples brought by the men.

The course was under the direct supervision of R. T. Stull, E. W. Washburn, and C. W. Parmelee, who were successively Heads of the Department during the years the course was given.

Clay-Product Plant-Operators' Conference.- The Clay-Product Plant-Operators' Conference was held for the first time on June 12-13, 1936, succeeding for this particular group, the Ceramics Short Course. It was given under the auspices of the Department of Ceramic Engineering in cooperation with the Illinois Clay Manufacturers' Association. Other similar meetings were held in May or June of each year following, the Sixth Conference coming on June 6 and 7, 1941. The attendance varied from 35 to 65, with registrants from several different states and Canada. The subjects

discussed at the meetings included topics of special interest to plant operators in the field of structural and refractory products.

<u>Conference on Glass Problems</u>.- The Conference on Glass Problems was held for the first time in June, 1934, under the auspices of the Department of Ceramic Engineering in cooperation with the Chicago Section of the American Ceramic Society with an attendance of about 50 from eight different states. The June ~~meeting~~ was such an outstanding success, even so far beyond any hope of expectations, that a
held on November 2-3, 1934. The attendance at the second meeting was
second meeting was/98,-84 of the registrants being out-of-town guests representing twelve different states. The Third Conference was held on May 31 and June 2, 1935, the Fourth, on May 5-6, 1936, the Fifth, on May 20-21, 1938, the Sixth on May 10-11, 1941, the Seventh on November 14-15, 1941 /and the eighth on November 16-17, 1944, with attendance varying from about 75 to 100.

The topics considered at these meetings included glass technology, glass wool, glass- house refractories, surface tension in molten glass, natural gas and the glass industry, oil and gas fuels, and glass manufacturing problems.

Professor C. W. Parmelee, Head of the Department of Ceramic Engineering, was in direct charge of all of the Conferences, except the last. That the meetings served a useful purpose is demonstrated by the following statement appearing in the "The Glass Industry", one of the ceramic trade journals: "The glass industry owes a debt of gratitude,-a debt that it may not fully realize,- to Professor Parmelee and his associates at the University of Illinois, for providing a forum on factory problems". Professor A. I. Andrews was in charge of the last one, having been Head of the Department since September, 1942.

<u>The Midwest Enamelers Symposium and the Porcelain Enamel Institute Forum</u>.- The Midwest Enamelers Symposium was held for the first time in 1934, under the auspices of the Department of Ceramic Engineering in cooperation with the Chicago Enameling Club. Another meeting was held in 1936. The attendance at these meetings was about 80, representing several different states and Canada.

In 1937, the Porcelain Enamel Institute, a national organization comprising the majority of the enamel companies in this country, sponsored its first forum and honored the Department of Ceramic Engineering and the University by holding it in Urbana on May 5-7. The attendance reached 200, 140 of the number being out-of-town registrants. The Institue then established the policy of alternating its meetings between the University of Illinois and Ohio State University, and held its third Annual Forum at the University on October 12-14, 1938. The attendance included, in addition to the 117 students and faculty members, 238 persons from out of town interested in the enamel industry, nine of whom were from England, one from Sweden, one from Russia, and one from Poland. The Fifth Forum was held here during October 16-18, 1940, the out-of town attendance being 198, with registrants from all parts of the United States and Canada.

The subjects considered at these sessions were those involving the production of enamels and enamel wares, such as the preparation of metal surfaces for enameling, methods of enamel control, drying problems, enamel application, and so on.

As a substitute for the regular Porcelain Enamel Institute Forum, a Short Course in Heat Treating for Porcelain Enamelers, sponsored by the Porcelain Enamel Institute in cooperation with the University of Illinois, was held in Urbana on November 2-5, 1942. The course of Instruction consisted of lectures and laboratory practice by members of the staffs of the Departments of Mining and Metallurgical Engineering and Theoretical and Applied Mechanics. Twenty-three persons registered for the course, and all were enthusiastic about the work given.

Conference on Air-Conditioning.- The conference on Air-Conditioning, held for the first time on May 4 and 5, 1936, under the auspices of the Department of Mechanical Engineering and again on March 8 and 9, 1939, under the auspices of the Department of Mechanical Engineering and the Engineering Experiment Station, included a two-day session devoted to the presentation of practical information on air conditioning to non-technically trained individuals interested in this particular field. The subjects considered at the meetings concerned equipment for air conditioning, duct

systems and fans, regulation of air temperature and humidity, building insulation, condensation problems, air-conditioning water supply, air filters, essential features of heating systems, research, factors affecting fuel saving, comfort conditions and air conditioning, and so on.

The attendance at the first session was 203, seventy-five per cent of whom were were from Illinois. The remainder were from 10 different states, one registrant being from Australia. The attendance at the second Conference was 275, composed of engineers, dealers, and salesmen from 11 states and the District of Columbia.

Professor A. P. Kratz was in charge of the programs for the University.

Diesel Engine Short Course.- In September, 1936, a number of representatives of midwest Land Grant Colleges and of manufacturers of Diesel engines held a conference at Madison, Wisconsin, for the purpose of considering the feasibility of offering a Diesel-engine short course. It was agreed that such a course would no doubt be worth while, and consequently during the second semester of 1936-37, seven Universities, not including the University of Illinois, entered into the scheme and conducted such a short course, with the cooperation of a number of manufacturers of Diesel Engines.

Inasmuch as this venture proved to be more or less successful, it was decided to repeat the course in 1938 during the period from April 20 to May 3, with the following Universities participating:

University of Illinois
University of Minnesota
Ohio State University
Michigan State College

The following manufacturers cooperated by providing lecturers, films, display equipment, etc.

Hercules Motor Company
International Harvester Company
Caterpillar Tractor Company
Waukesha Motor Company

Manufacturers' exhibits were transportated on trucks which moved from school to school in accordance with a definite schedule, two days being allotted to

each manufacturer at each school. The lecture material on maintenance and operation of Diesel engines was well prepared, and each lecture was illustrated with lantern slides, display models, and actual working models.

With all of this, there were only eight persons registering at Illinois. These came from different points within the State, and most of them had had practical experience in the maintenance and operation of gasoline engines. Professor J. A. Polson was in general charge of the course at the University with J. R Fellows and J. C. Miles, instructors assisting.

Short Course on the Design and Control of Concrete Mixtures.- A short Course on the Design and Control of Concrete Mixtures was held at the University on November 26 and 27, 1928, under the auspices of the Illinois Society of Engineers. Much of the instruction was given by members of the Department of Civil Engineering.

B. CORRESPONDENCE OR HOME-STUDY COURSES

General.- In 1933-34, the University decided upon the general policy of offering correspondence or home-study courses in order to provide instruction to those individuals that desire to carry forward their educational programs, but who are not able to attend the University or to take advantage of the instruction offered in extension centers. At that time, practically all of the departments within the College of Engineering arranged for instruction of this type for a few of the more elementary subjects in their several curricula. The materials offered in these courses, most of which are still being given, are essentially the same in scope and content as those given in the class room. The credit is the same as for resident class-room work and within certain limits, may be counted towards a baccalaurate degree. The students buy the books and other supplies required and do the assignments at home. The instruction is administered by the same teachers that conduct the class-room exercies, but is carried on through the office of the Director of University Extension. The courses that have been given or are being now given are as follows;

Mechanical Engineering.- In 1934-35, the Department of Mechanical Engineering offered

M.E. X6,	Steam Power Plant Engineering,	4 hours
M. E.X17,	Mechanical Refrigeration,	3 hours
M.E. X28,	Heating, Ventilating, and Air Conditioning	4 hours
M.E. X31,	Mechanics of Machinery	5 hours

M.E. X31 was dropped in September, 1936, and the other three in January, 1938. This was made necessary by the teaching loads imposed upon the instructors by the large increase in enrollment of residence students.

Physics. In 1933-34, the Department of Physics offered by correspondence courses.

Phys. X1a,	Theory of Mechanics, Heat and Sound	3 hours
Phys. X1b,	Theory of Electricity, Magnetism, and Light.	3 hours

Both of these courses are being given in 1945.

Theoretical and Applied Mechanics.- In 1933-34 the Department of Theoretical and Applied Mechanics offered three courses in mechanics as follows:

T.A.M. x1	Statics	2 hours
T.A.M. x2	Dynamics	3 hours
T.A.M. x3	Resistance of Materials	3 hours

All of these subjects are still being given in 1945.

Electrical Engineering.- One electrical-engineering course was offered for study by correspondence in 1933-34 and is still being given in 1945, viz:

E.E. x56 Electrical Power Equipment, 4 hours credit

General Engineering Drawing.- General Engineering Drawing offered five courses for correspondence study in 1933-34.

G.E.D. x1	Elements of Drawing	4 hours
G.E.D. x2	Descriptive Geometry	4 hours
G.E.D. x4	Advanced Drawing	4 hours
G.E.D. x7	Architectural Projections	2 hours
G.E.D. x8	Architectural Projections, Cont'd	2 hours

G.E.D. x4 was dropped in September, 1942; all the others are still being carried on in 1945.

Railway Engineering.- Railway Engineering offered four courses in 1933-34:

R.E.	x3	Locomotives	2 hours
R.E.	x4	Locomotives, cont'd	3 hours
R.E.	x25	Railway Development	2 hours
R.E.	x61	Electric Traction	3 hours

All of these were discontinued in September, 1940

Mining Engineering.- Mining Engineering offered only one course for correspondence study in 1933-34, but has continued it to date, viz:

Min. E.	x2	Mining Principles	3 hours

Civil Engineering.- Civil Engineering offered four correspondence courses in 1933-34 when the plan was adopted: These include:

C.E.	x20a	Highway Construction	3 hours
C.E.	x60	Bridge and Building Construction	3 hours
C.E.	x61	Structural Stresses	4 hours
C.E.	x63	Theory of Reinforced Concrete	2 hours

All of these are still being listed for correspondence study in 1945.

Miscellaneous Courses.- A number of other courses required in the curricula in engineering were given for correspondence study in 1933-34. These included:

Math.	x2	Algebra	3 hours
Math	x3	Algebra	5 hours
Math.	x4	Plane Trigonometry	2 hours
Math.	x6	Analytical Geometry	5 hours
Math.	x7	Calculus	5 hours
Math.	x9	Calculus	3 hours
Rhet.	x1	Rhetoric	3 hours
Rhet.	x2	Rhetoric	3 hours
Hyg.	x3	Hygiene and Sanitation	2 hours

All of these are still being offered in 1945.

The particular advantage of home-study instruction is that a student can begin at any time and carry the program to completion as his regular work permits; and ~~while~~ while he loses the advantages derived from group discussion, he has a better opportunity to think things through when placed upon his own responsibility and to apply what he learns in his daily practice.

C. EXTRAMURAL COURSES

General.- Extramural courses for credit in the Graduate School were first offered in September, 1936. The first course in engineering under this new plan was one in civil enginering given in Chicago. As the plan has worked out, classes are in charge of the regular members of the faculty and the work is equivalent to that in courses listed with the same numbers for students in residence at the University. The duration of each course is practically one semester. A person may be admitted to these courses as a regular student, as a special student, or as a visitor. The regulations regarding admission, credit, grades, examinations, etc., for resident students in the Graduate School apply to students taking extramural courses for graduate credit. Since September 1941, no more than four units earned through extramural courses may be applied towards meeting the requirements for the master's degree.

The following courses were offered in 1936-37 under this new plan of instruction:

Civil Engineering.-

C.E. 106, Continuous Frames, by Professor Cross, Registration 78, First semester

C.E. 108, Continuous Frames, by Professors Cross, Wilson, and Shedd. Registration 32, second semester

Only a small number took these courses for credit although the registration was relatively large.

During the year 1937-38 these courses were taught by Professor T. C. Shedd. During 1938-39, Professor W. M. Wilson taught the first-semester course and Professor W. C. Huntington, the second. Professor Shedd taught a graduate course in Springfield during the entire year and also during 1939-40.

None of these courses, however, have been given since the beginning of World War II.

General Engineering Drawing.- During the second semester of 1937-38, Professor Springer of the Department of General Engineering Drawing, went to Decatur twice a week to teach evening extension courses in elementary drawing and descriptive

geometry. The enrollment in the two courses was 21. Like those in the preceding, none of these courses have been held off the campus, since the beginning of World War II.

Aside from any credit value which such courses have when taken as new material, they serve the useful purpose of keeping those abreast of their industry who have neverhad formal instruction in the particular subjects and of refreshing the memories of those who may have previously covered the ground, but have forgotten some of the essential points involved.

D. ENGINEERING EXTENSION

National Defense Program.- During the summer of 1940 and the school year of 1940-41, the Departments of Mechanical and Electrical Engineering gave several shop courses below the grade of college level under the National Defense Program in cooperation with the Vocational Educational Department of the Champaign Public School System. The classes in mechanical engineering dealt with machine-shop practice, welding, and heat-treatmentof metals. Those in electrical engineering were concerned with the operation of elementary equipment in electrical engineering. Some of the work was given in the Champaign school shops and laboratories and the remainder in the University laboratories. Enrollment included both day and evening classes.

Engineering, Science, and Management War Training.- During the summer of 1941, the Department of Electrical Engineering instituted a war-time course of College level in Decatur at the finish of which twenty-four men received certificates indicating the extent of the work covered. Encouraged by this experience of interest and attendance and prompted by other motives also, Engineering Extension, as a part of the division of University Extension, was organized in July, 1941, for the purpose of making available to the industries of the State, more of the University's resources for the training of war workers. To accomplish this aim, a program of Engineering, Science, and Management War Training was inaugurated in cooperation with the U.S. Office of Education,- the Office providing $300,000 of federal funds for the fiscal year 1941-42. Mr.Harry Clay Rountree formerly of Pennsylvania State College was employed as Supervisor of Engineering Extension, to cooperate with the

University staff in outlining and administering the program of a substantial list of courses on the college level. The courses were developed on the basis of meeting localized needs of the different communities and industries of the State, and were planned to give practical aid to trainees already employed or eligible for immediate employment in particular plants doing war work or in contributing industries, such as public utilities or power plants.

During that first year, the Department of Civil Engineering offered several ESMWT courses in various parts of the State. Many of them were in some phase of sanitary engineering and were conducted in cooperation with the State Department of Public Health; others were given in the field of structural engineering.

Another phase of ESMWT work was the development of an ultra-high frequency course dealing with ultra-short wave radio transmission applicable to problems of modern warfare. Thirty-five senior students enrolled for study in this particular part of the war-time program. During the year, in addition, classes in supervisory training and in personnel and industrial relations were taught in Peoria, Mattoon, and Urbana by members of the Department of Mechanical Engineering. At the same time, a course on the heat treatment of steel was offered in several Illinois cities, while courses in physics were given in different parts of the State. Furthermore, classes in general engineering drawing were held, some on the campus, and others in Danville, Mattoon, and Quincy.

The first year's report showed that 33 subjects, taught in 236 sections, were administered to 6,309 students representing 29 communities in the State.

During 1942-43, there were a number of National Defense classes held on the campus by the Department of Mechanical Engineering. The day courses consisted of U.S. Civil Service Aircraft Radio Inspector Training and Engineer Aircraft Radio Signal Corps Apprentice Training. Night courses were offered in Vocational Training for Machine Tool Operators under the supervision of the Champaign High School.

Classes in industrial relations were held during the year in Mattoon and Champaign also by members of the staff of Mechanical Engineering with registrations

running from twenty to thirty students per section.

The Department of Electrical Engineering continued during 1942-43 with the following program for ESMWT courses on the college campus:

During eighteen weeks after May 25, 1942, a course was given for men who had an undergraduate course in electrical engineering or who had completed completed/a substantial part of such an undergraduate course. A second course beginning on June 19, 1942, and continuing for twelve weeks, was given to men who had completed the electrical-engineering curriculum at some recognized college of engineering within a period not exceeding twelve years. A third course was opened on August 2, 1942, and continued for twenty-four weeks that was designed for young men who had been graduated from a first-class high school, and a fourth course running for twenty-four weeks from March 8, 1943, was designed for young women who had completed at least two years of college work or its equivalent.

All of these courses required eight hours of class-room attendance each day for six days a week. Men completing the first two courses were trained for commissioned officers in the Signal Corps. Persons completing the second two courses were assigned as laboratory technicians at the Government airplane plant at Dayton, Ohio.

During the school year 1942-43, also, the Department of Electrical Engineering administered courses in thirty-five industrial centers of the State. In these centers, 109 sections, with an average enrollment of over twenty-five students each were organized.

The Department of General Engineering Drawing also continued with its work in the supervision of drawing classes in a number of communities throughout the State.

The ESMWT program thus administered during 1942-43 was comprised of about 60 subjects,[1] chief among which were the following: Elements of Electrical Engineering; Electrical Circuits; Power Circuits and Machines; Fundamentals of Raido; Ultra-high Frequency Techniques; Principles and Techniques of Radio Communication for Signal Corps; Chemistry of Powder and Explosives; Ordnance

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1. Alumni News, October 7, 1942.

Material Inspection and Handling; Sanitary Engineering for Emergencies; Pre-foremanship Training for Production Supervision; Supervisory Training; Elementary Engineering Drafting; Advanced Engineering Drafting; Shop Mathematics; Production Engineering; Elementary Machine Design; Motion and Time Study; Safety Engineering; Personnel and Industrial Relations; Heat-Treatment of Metals; Foundry SandControl; Engineering Chemistry; Pyrometry; Mathematics, Mechanics, and Strength of Materials; Stress Analysis; Theory and Practice of Reinforced Concrete Design; Engineering Physics; Elementary Tool Design; and Industrial Cost Accounting.

The instruction was carried to a total of almost 17,00C persons representing 54 communities of the State, some of which were the following: Alton, Granite City, East St. Louis, Belleville, Highland, Hillsboro, Mt. Carmel, Centralia, Mt. Vernon, Carbondale, Lawrenceville, Robinson, Mattoon, Taylorville, Decatur, Springfield Beardstown, Quincy, Pekin, Macomb, Galesburg, Moline, Rock Island, Dixon, Rockford, Freeport, La Salle, Ottawa, Kewanee, Elgin, Aurora, St. Charles, Joliet, Chicago Heights, Waukegan, Oak Park, Franklin Park, Harvey, Blue Island, Cicero, Maywood, Elmhurst, Highland Park, Calumet City, Danville, Urbana, Bloomington, Effingham, and Peoria.[1]

These same extension courses and some additional ones, were continued during 1943-44, the total registration reaching about 20,000. The work of administering these courses throughout the State during the last year as in the previous two, required the services of a number of special instructors and supervisors in addition to those from the University staff. This same instructional program including some additional subjects was carried forward through the 1944-45 season.

During the period from July 1, 1941, to July 1, 1945, when the project was financed by the U.S. Government through the Federal Office of Education, approximately 168 courses were given throughout the State providing training for 39,000 workers, 3,000 of whom were women, engaged in some phase of war production in 3,200 Illinois industries located in 79 communities of the State. About

1. Alumni News, October 7, 1942.

80 faculty and staff members of the University served as instructors and educational supervisors in addition to 500 part-time instructors.

Since July 1, 1945, the educational program has been carried on at State expense, having been administered by the Division of University Extension as before. There has been little change in administrative policy except that the work has been extended to include practically all phases of general industry.

School for Diesel-Engine Officers.- A course entitled "Theory and Practice of Diesel-Engine Operation" was given on the University campus from September 14, 1942, to Febraury 13, 1943 under the ESMWT program. The students were naval officers and the instructors, Professor P. E. Mohn and Mr. J. C. Miles of the Department of Mechanical Engineering, and Mr. H. P. Batemen of the Department of Agricultural Engineering, were on leave from their departments for this particlar assignment. The class meetings were conducted for four hours a day, six days a week for ten weeks in battallions of about 150 men, -there having been 143 enrolled in Class No.1, which began Sept mber 14, 1942; 155 in Class No. 2, which began on November 2,1942; and 155 in Class No. 3, which began on December 7, 1942. The class instruction consisted of six two-hour lectures, five one-hour discussion periods, one two-hour quiz period, and five one-hour supervised-study periods per week. These classes were held in the New Agriculture and Commerce Buildings. Professors A. R. Knight, C. A. Keener, and M. A. Faucett of the Department of Electrical Engingering and Mr. Francis Seyfarth of the Department of Mechanical Engineering assisted by giving special lectures. In addition to the classroom work, the trainees had six four-hour periods of laboratory instruction administered and conducted by Navy personnel in the laboratory established for the purpose in the West Hall of the Memorial Stadium These men were housed and messed in Busey and Evans Residence Halls.

CHAPTER XXV

THE ENGINEERING EXPERIMENT STATION

A. DEVELOPMENT

Purposes that could be served by an Engieeering Experiment Station at the University of Illinois.- While everyone recoginzed that the primary function of the College of Engineering was the education and training of the youth of the State to become honorable, useful, and successful citizens in the conduct of public and private enterprise, there were many here in the early days of the University that recognized the possibilities which could be gained from a well-balanced program of systematic research as a service complementary to engineering instruction. Because of this foresight, experimental work of various kinds had been carried on in a limited way by faculty and students of individual departments in the College of Engineering for a number of years, but it seemed advisable to expand the work, improve the methods, coordinate the efforts, and centralize the direction in order to secure the greatest benefits for the greatest numbers.

The most obvious particular purposes that could be served by the establishment of an Engineering Experiment Station in the College of Engineering would be, "to conduct investigations and make studies of importance to the engineering, manufacturing, railwway, mining, and other industrial interests of the State",- the same motive that prompts private enterprise engaged in large-scale production to set up full-time research departments as permanent divisions of their organizations. It could thus extend the field of scientific knowledge by discovering new principles and laws and supply thereby the increasing need for information regarding the structure, characteristics, and action of engineering materials, so as to develop new fields of enterprise and to improve these already established; for there was an urgent and growing need for reliable information concerning the nature and properties of the materials of production and their proper utilization in engineering construction.

Another purpose to be gained by providing for a research division would be to improve teaching processes and develop new materials for classroom and laboratory use, thereby enriching engineering education itself, and keeping the University work abreast of the progress of the engineering and industrial world. It would provide a means for educating and training graduate students in the methods of conducting research, for they, themselves, could take part in many of the laboratory experiments. It would serve to encourage the undergraduate students, who seeing new knowledge in the process of development, would be inspired to undertake investigations on their own accounts thereby broadening their mental horizons, stimulating self-reliance, and cultivating initiative.

Another advantage of a separate Station would be to provide more money for research projects, for one of the obstacles to individual effort was the lack of funds. During the time when the College was developing, many calls came from those seeking aid in their problems by requesting tests of fuels, engineering materials, manufactured products, and production methods, but there was not sufficient means to meet the demands. By setting up a coordinating and designated directing agency, it would be possible to secure larger appropriations and to operate with increased efficiency. The establishment of a research organization and the addition of equipment, together with a moderate allotment of funds and a small staff of assistants, would put new zest into experimental efforts, for it would open up great possibilities of achievement.

<u>Founding of the Station</u>.- Much of the credit for the conception of the idea of a Station and for the establishment of the enterprise belongs to Professor L. P. Breckenridge, Head of the Department of Mechanical Engineering, who for the several years preceding, had been active in an attempt to secure Federal action establishing engineering experiment stations similar to the agricultural experiment stations. Failing in this objective, however, he proposed that the University should establish such an institution with State Funds. As an outcome of his efforts in this direction, the Board of Trustees of the University, in preparing its list of items for legislative appropriation in December, 1902, included in a separate

bill a request for funds to expand the activities of the College of Engineering. Faculty members, alumni, and manufacturing and construction interests of the State joined in support of the measure.

To the satisfaction and gratification of the University administration, the General Assembly recognized the needs of the College of Engineering, and in May, 1903, passed the general bill carrying an item of $150,000 for the expansion and maintenance of engineering equipment. On the basis of a report, prepared after careful deliberation by the heads of the department within the College, President Draper presented to the Board of Trustees a recommendation that $43,000 of the appropriation be devoted to the purchase of land and the erection of two buildings,-the Mechanical Engineering Laboratory and a foundry, -and for the purchase of equipment for undergraduate instruction, that $30,000 be used by the departments for additional equipment, and that $77,000 be used for the purchase of apparatus to be used for advanced work in engineering research and for experimentation in engineering problems, the research to be carried out by the regular departments. The recommendation of the President was adopted by the Board of Trustees on December 8, 1903. Thus, there came into existence at that time, a research organization within the College of Engineering that was the first of its kind to be established in an educational institution in this country and that was destined to serve as a pattern for the many others which have been establieshed elsewhere since.

Administration of Station Affairs. Although the first bulletin was issued in September, 1904, there was no formal organization of the Station until June, 1905,- the first meeting of the new executive staff being held on June 14, following. In this manner, by authority of the Board of Trustees, the work of the Station came to be administered by the Director, who since 1909, has been the Dean of the College of Engineering, and an executive staff composed of the heads of the several departments within the College of Engineering and of the head of the division of Industrial Chemistry, or as it became later, the division of Chemical Engineering of the Department of Chemistry in the College of Liberal

bill a request for funds to extend the activities of the College of Engineering. Faculty members, alumni, and manufacturing and construction interests in the State talked in support of the measure.

To the satisfaction and gratification of the University administration, the General Assembly recognized the needs of the College of Engineering, and in May, 1903, passed the general bill carrying an item of $150,000 for the expansion and maintenance of engineering equipment. On the basis of a report, prepared after careful deliberation by the heads of the departments within the College, President James presented to the Board of Trustees a recommendation that $75,000 of the appropriation be devoted to the purchase of land and the erection of two buildings—the Mechanical Engineering Laboratory and a foundry, and for the purchase of equipment for undergraduate instruction; that $50,000 be used by the departments for additional equipment, and that $25,000 be used for the purchase of apparatus to be used for advanced work in engineering research and for experimentation in engineering problems, the research to be carried out by the regular departments. The recommendation of the President was adopted by the Board of Trustees at December 8, 1903. Thus, there came into existence at that time, a research organization within the College of Engineering that was the first of its kind to be established in an educational institution in this country and that was destined to serve as a pattern for the many others which have been established elsewhere since.

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Arts and Sciences. This group is vested with authority to determine the lines of investigations to be undertaken, to pass upon results, and to supervise the publications. All apparatus purchased is under the direction of the department for whom it was procured. The head of each department is largely responsible for the research work carried on in his department.

On September 1, 1943, there was established the newly-created office of Assistant Director of the Engineering Experiment Station to promote and coordinate research programs of the Station with those of other colleges and schools of the University and of other service departments of the State.

Equipment and Facilities.-While the regular equipment devoted primarily to instructional purposes in the College of Engineering is generally available for experimental use when not engaged for class room and laboratory purposes, there are many instances where additional facilities are necessary to carry on experiments on special projects. All of these appliances have been previously described at some length along with mention of other items of interest in the departments to which they have been assigned. In most cases involving cooperative effort, portions of the equipment, materials, and other facilities have been supplied by the outside agencies. For example, in experiments involving carwheel tests,the manufacturers have supplied the wheels,and in tests involving locomotive performance, the carries have furnished the rolling stock.

Experiment Station Quarters.-Although the central office of the Engineering Experiment Station has always been located in Engineering Hall, the Experimental work of the Station has never been centered in any one building on the campus,but is carried on wherever the equipment and facilities are available. Sometimes it has been appropriate and even necessary to use the equipment of some of the other agencies of the State, such as the State Geological Survey and the State Water Survey, the facilities of the Federal Bureaus, such as the U. S. Bureau of Mines and the Bureau of Standards, and the plants of private enterprise, such as railroad lines and steel mills.

Levels Established for Station Performance.-From the beginning, it was the established and settled policy that the character of the investigations maintained under authority of the Engineering Experiment Station should be substantial, high-grade,thoroughly scientific and unbiased, - that is, the work that should be carried on with the greatest degree of accuracy attainable with facilities available. The animating purpose was to establish fundamental principles applicable to the solution of every-day engineering problems, and not merely to carry on commercial tests or collect data that would provide good material for propoganda purposes. The determinations should be safeguarded with jealous care in every way, and the results passed on to the public as the highest attainments in a particular line, as reliable, trustworthy, and worthwhile contributions to the science of engineering.

<u>Collaboration between the University and other State Departments</u>.- In many instances, there is collaboration not only between members of the same department, in the conduct of research but also between members of different departments where there is an overlapping of interests in associated fields. There is collaboration, also, between departments in the College of Engineering and divisions of the State Water Survey and State Geological Survey, both of which are located on the University grounds. In addition, there is collaboration between departments in the College of Engineering and the Division of Illinois Highways on problems involving highway engineering and administration.

<u>Finances</u>.- Many of the experimental projects initiated by members of the College or Station staff have been carried on with equipment already available without the need of extra funds. Other projects originating within the College, have required additional aid that has been supplied by regular allowances made for the purpose from State appropriations. Still other projects, however, many of which have been suggested by outside agencies representing professional and industrial interests, have been financed by private funds through cooperative effort, because they required more money than the University had available for such purposes. These are discussed in the following section.

<u>Cooperative Investigations</u>.- In the case of cooperative investigations, the University supplies such staff and facilities as it has available for such use, including laboratories and equipment, and heat, light, and power. The cooperating agency supplies the rest and provides the funds necessary to bring the investigation to a successful conclusion. The agreement in such instances generally provides, however, that the University shall direct and supervise the experiments and publish the results.

The University has not entered into cooperative agreement or arrangement except in cases where the cheif purpose was to establish fundamental principles and to develop scientific information of vital importance that would have a general application to a wide group of engineers or Manufacturers. In general,

it has not been interested in undertaking such work as the testing of a device or invention, where the particular advantages or gains would accrue to a single individual or organization at the expense of the State, unless in the long run the public would benefit from the experience in the form of improved products or services.

Form of Contract for Cooperative Investigation.- On September 14, 1920, the Board of Trustees approved the following regulations governing the drafting and administering of contracts[1]:

"1. Contracts shall be drafted in tentative form by the University Office (Or officers) who is best acquainted with the subject matter thereof, and in whose department lies the responsibility for the execution thereof, and approved by the President of the University.

"2. All contracts prior to execution thereof shall be approved as to legal form by the University counsel; such approval to be endorsed in writing on the contract.

"3. All contracts shall be executed at least in duplicate; an original thereof shall be filed with, and remain in custody of, the Secretary of the Board of Trustees.

"4. The Secretary of the Board of Trustees shall immediately file a true copy of all contracts, one in the office of the Comptroller of the University, and one with the proper officer in charge of the department immediately concerned with the execution of the subject matter of the contract.

"5. All University contracts shall be executed as follows, to wit:

(a) All major contracts or those involving some general policy shall be signed by the President and Secretary of the Board of Trustees, unless directed to be otherwise executed by the Board of Trustees or the Executive Committee thereof.

(b) Minor contracts and those involving the purchase of ordinary supplies, advertising and publicity matters, and other routine matters in the ordinary operation of University affairs, shall be signed by the Secretary of the Board of Trustees and by the Comptroller of the University, to whom authority is hereby delegated by the Board for such purpose.

(c) All contracts must have the seal of the University attached."

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1. Report of the Board of Trustees, 1920, pages 77-78.

it has not been interested in undertaking such work as the [illegible] of a [illegible] or [illegible], where the particular advantages or gains would accrue to a single [illegible] or [illegible] at the expense of the State, unless it was clear that the public would benefit from the [illegible] in the form of improved [illegible] or [illegible].

Rules of Contract for University Investigations.— On September 14, 1917, the Board of Trustees approved the following rules governing the [illegible] and [illegible] of contracts[1]:

"1. Contracts shall be [illegible] in executive form by the University Officer (or officers) who is most concerned with the subject-matter thereof, and in whose department lies the responsibility for the execution thereof, and approved by the President of the University.

"2. All contracts calling for [illegible] shall be approved as to legal form by the University counsel and approved to be so declared in writing by the Comptroller.

"3. All contracts shall be [illegible] as [illegible] by the [illegible], and [illegible] shall be filed with, and [illegible] the [illegible] of the [illegible] of the Board of Trustees.

"4. The Secretary of the Board of Trustees shall immediately file a true copy of all contracts, one in the office of the Comptroller of the University, and the [illegible] in charge of the department immediately concerned with the execution of the subject matter of the contract.

"5. All University contracts shall be executed as follows, to wit:

(a) All major contracts or those involving some general policy shall be signed by the President and Secretary of the Board of Trustees, unless otherwise [illegible] by the Board of Trustees or the Executive Committee thereof.

(b) Minor contracts and those involving the purchase of ordinary supplies, [illegible] and [illegible], and other routine matters by the ordinary operation of University offices, shall be signed by the Secretary of the Board of Trustees and by the Comptroller of the University, or other authority as [illegible] by the Board for such purpose.

(c) All contracts shall bear the seal of the University [illegible]."

1. Minutes of the Board of Trustees, 1917, pages [illegible].

The following agreement governing the conduct of cooperative investigation is in effect in 1945:

ARTICLES OF AGREEMENT between the Board of Trustees of the University of Illinois, Urbana, Illinois, Partyof the First Part, hereinafter called the University, and

(Enter here name and
address of second party
to the agreement, using
corporate or other
legal title.)

Party of the Second Part, hereinafter called the Sponsor, for a cooperative investigation described as follows:

the investigation to be carried out by the University through

one of its research agencies, under the terms and conditions specified herein.

(1) This agreement is executed for the following period:

with the understanding that it may be extended for additional periods under the same terms or such other terms as may be mutually agreed upon; provided that the sponsor shall request such extension in writing not less than thirty(30) days before this original agreement expires. The University reserves the right to decline to extend this agreement beyond the expiration date if the scientific or scholarly results realized or reasonably anticipated do not in the judgment of its officials warrant continuation of the program.

(2) The University will supervise and direct all experimental work and the computation and reduction of all results obtained, together with the placing of these data into form for presentation.

(3) The University will furnish the necessary space for this investigation, together with heat, light, power, and water. In addition, it will permit the use of such laboratory apparatus and experimental facilities as it may possess which are not in use for other purposes. It is agreed, however, that apparatus, equipment, and and other facilities not available in the laboratories of the University, and all materials and supplies required in the investigation, shall be purchased from and charged against the funds for this investigation provided by the Sponsor.

(4) The conduct of the investigation shall be under the full control of the University.

(5) All records of the investigation are to be the property of the University and the Sponsor. The original records shall be kept on file by the University, but copies of all such records shall be furnished the Sponsor or his duly authorized representative on request. The University shall have the exclusive right to publish the results of the investigation when completed, in the form of a bulletin or bulletins, or otherwise. No account of a cooperative research project shall be published by the Sponsor or by any other agency, except upon approval of the division of the University or head of the Department in which the work is being done.

Prior to such publication, no publicity shall be given to any of the results of the investigation except upon the recommendation of with the approval of the University and the Sponsor, unless the scientific value of a discovery made during the course of the investigation be such that, in the judgment of the University, the public interest requires prompt release or publication thereof. The publication, if any, shall contain a description of the investigation and a report of the results and conclusions; full credit shall be given the Sponsor and every person and agency having made a significant contribution to the results obtained.

(6). Authorized representatives of the Sponsor shall at all times have access to the data secured and results computed from the investigation, subject, however, to the restrictions named in Article 5. The University will submit such reports of progress to the Sponsor as may seem desirable. An Advisory committee may be named by the parties to consist of such persons and have such duties as may be mutually agreed upon.

(7) It is agreed that all results of experimental work, including patentable discoveries, carried on under the direction of the scientific staff of the University, belong to the University and to the public and shall be used and controlled so as to produce the greatest benefits to the public.

It is agreed that if patentable discoveries grow out of the investigation and such discoveries have commercial value, the Sponsor, upon payment of the entire cost of securing a patent, shall be given free use of the patent as a non-exclusive licensee, it being agreed that other licensees shall pay the University a royalty which in the opinion of the University is fair to the Sponsor and to the Public.

The Sponsor shall notify the University in writing whether it will pay the costs of filing an application and procuring a patent on any discoveries which may be patentable within sixty (60) days from the date when the University gives the Sponsor notice of any such discovery. In case the Sponsor does not wish to assume the expense of securing a patent, the University may, in its discretion do so, and the Sponsor shall be given a non-exclusive license on substantially similar terms as other licensees.

(8) The money contributed for this investigation shall be held as a special fund and shall be so carried on the books of the University. Payments from this fund shall be made only on vouchers approved by officers of the University in immediate or supervisory charge of the investigation. At the close of the period covered by this agreement, the Comptroller shall render an accounting to the Sponsor.

As partial reimbursement to the University for indirect costs and to provide for employer contributions for annuities, disability, and death benefits, a general charge of
will be deducted from the payments made by the Sponsor.

(9) The sponsor agrees to pay to the University the Sum of

to cover the expenses of this investigation, such payments to be according to the following schedule:

(Checks should be drawn payable to the "University of Illinois" and remittances should be sent to the Comptroller, University of Illinois, Urbana, Illinois.)

IT IS UNDERSTOOD AND AGREED THAT the payment of the above sum as stipulated is conditioned upon the conduct of the investigation by the University with due diligence so as to secure the greatest possible progress consistent with the nature of the work.

(10) All technical, clerical, and other personnel necessary for the effective prosecution of this investigation shall be employed by the University and paid from funds provided by the Sponsor. Such personnel shall be employees of the University during their employemnt in this investigation and shall in all respects be subject to the rules and regulations of the University governing staff members and employees.

(11) It is agreed that under no circumstances will the Sponsor state or imply in any advertisement or other published announcement that the University has tested or approved any manufactured product, manufactured, sold, or distributed under a specific brand, name, or trademark. It is also agreed by the Sponsor that it will not under any circumstances use the name of the University in any advertisement, whether with reference to the cooperative agreement or any other matter.

IN WITNESS WHEREOF, the authorized officers of the respective parties have hereunto set their hands and the seals of the parties, this____________________
(Date)

day of____________________, 19______.
(Month)

APPROVED FOR THE UNIVERSITY BY:

____________ Head of Department	______ (Date)	THE BOARD OF TRUSTEES OF THE UNIVERSITY OF ILLINOIS, PARTY OF THE FIRST PART
____________ Dean or Director	______ (Date)	By____________ Comptroller
____________ (As to legal form)	______ (Date)	By____________ Secretary
		____________ Party of the Second Part
		By____________
		By____________

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B. PERSONNEL

Director.- Professor L. P. Breckenridge, Head of the Department of Mechanical Engineering, was Director from June 2, 1905, to September 1, 1909. After that time, the Dean of the College automatically became Director by authority of the Board of Trustees. Accordingly, Dean F. W. M. Goss was Director from September 1, 1909, to July 1, 1913; and again from September 1, 1915, to March 1, 1917. Dean C. R. Richards was Acting Director from July 1, 1913, to September 1, 1915; and Director from March 1, 1917, to September 1, 1922. Dean M. S. Ketchum was Director from September 1, 1922, until September 1, 1933. Dean A. C. Willard was Director from September 1, 1933, until September 1, 1934. Dean M. L. Enger has been Director from September 1, 1934 to date. Biographical sketches of these men are given under Deans in another chapter of this publication.

Assistant Director.- On September 1, 1943, Maurice K. Fahenstock became the first Assistant Director of the Station.His biographical sketch appears under Mechanical Engineering.

Assistants to the Director.- The following have served as Assistant to the Director, in immediate charge of the correspondence, preparation of the illustrations, proof reading, and publication of bulletins, and in charge of mailing, and so on.

R. W. Rutt. m.e. '03	from July 29, 1905, to May 18, 1910
E. A. Swift	" October 24, 1910, to April 24, 1912
T. D. Yensen, e.e. '07	" September 30, 1912, to January 27,1913
A. K. Chittenden	" February 11, 1913, to July 4, 1914
T. W. Dieckman, L.A.& S. '15	" September 24, 1914, to July 3, 1915
C. S. Sale	" November 29, 1915, to May 20, 1918
F. D. Crawshaw	" February 17, 1919, to May 5, 1919
M. R. Riddell	" January 12,1920, to November 1, 1945
Helen H. Peffer	" November 1, 1945 to date

Biographical sketches of some of these persons follow.

Roy Weaver Rutt, (B.S. in M.E., 1903, University of Illinois), was engaged in engineering practice after graduation until 1905, when he became Assistant to the Director of the Engineering Experiment Station here. He continued with the Station work until 1910, when he resigned to accept a position with the Western Electric Company at Chicago.

Elizabeth Andrews Swift, (A.B., 1909, L.and A., University of Illinois), served as Assistant Editor in the Engineering Experiment Station from Oct. 1910 to April, 1912.

Alfred Knight Chittenden, (Ph. B., 1900, and M.F., 1902, Yale University), was employed in forestry service until 1913-the years 1905-13 being with the U. S. Government. He served as Lecturer on Timber Resources at the University of Illinois during 1913-14 and as Assistant to the Director of the Station from February, 1913, to July, 1914.

Thomas Wilbur Dieckmann, (A.B., 1915, University of Illinois), served as Assistant to the Director of the Station from September, 1914, to July, 1915, while he was a senior in the College of Liberal Arts and Sciences here at the University. Mr. Dieckmann left the station to continue in Engineering practice.

Helen H. Peffer, (A.B., 1919, University of Kansas; A.M., 1927, University of Illinois), was Editorial Assistant in the Agricultural Experiment Station here from 1923 to 1927 and Assistant in Journalism from 1927 to 1930. She then served with Refrigerating Engineering in New York until November, 1945, when she became Editor in the Engineering Experiment Station.

The biographical sketches of the others on the list are given elsewhere in this publication,- T. D. Yensen under Electrical Engineering, C.S. Sale under Civil Engineering, F. D. Crawshaw under Assistant Deans, and M.R. Riddell under Mechanical Engineering.

Draftsman.- On February 3, 1918, Mr. Elmer Franklin Heater, who was graduated from the Department of Electrical Engineering at the University of Illinois in 1911, began as draftsman for the Engineering Experiment Station in the work of editing and preparing of drawings for bulletins and circulars authorized for publication by the Station,-a work he has continued to date. From 1932 to 1939, Mr. Heater had the title of Research Assistant and from 1939 to 1941, Research Associate. Since 1941, he has had the rank of Research Assistant Professor.

Research Staff.- The work of investigation is conducted in part by members of the instructional staff, who give as much time to research as their regular class-room and laboratory duties permit, for most persons recognize that the best way to advance themselves and the interests of their students and the College generally is to carry on some kind of research. The greater part of the research work of

the Station, however, is carried on by the Research Corps, which includes a number of full-time investigators, by special investigators employed for a limited period on some particular project, and by a group of Research Graduate Assistants, who devote half of their time to research work of the Station and the other half to graduate study in engineering, as described more fully in the following paragraph.

Research Graduate Assistantships.- In 1907, the Board of Trustees voted that the Engineering Experiment Station be authorized to offer ten fellowships of an annual value of $500 each. The number was later increased and the value improved until in 1945, the University normally maintains fourteen graduate assistantships at $600 each that are assigned to the Station. In addition, several other assistantships are generally maintained by industrial firms,-the number varying from year to year according to circumstances. These assistantships are open to graduates of approved universities and colleges, who are prepared to undertake graduate study in engineering, physics, or chemical engineering, with exemptions from tuition and laboratory fees in courses that count for graduate credit. Appointment must be accepted for two consecutive collegiate years, at the end of which time, when all requirements have been met, the student will receive the degree of master of science. Not more than one-half of the student's time is generally required for more than ten months of the year to be spent upon the investigations. The remainder of his time is available for graduate study.

These young men carry out the details of the experiments, working directly under a senior member of the staff who has had long years of training in methods of conducting research. This relationship provides a splendid opportunity for young men to become trained in methods of laboratory research and scientific experimentation and to acquire individual and creative initiative in the conduct of investigational practice,-all vital factors in the preparation for professional life. The work, including the securing of data, the checking and rechecking of results, the preparation of charts and diagrams involving extensive computations in many cases, and the presenting of the results in suitable form for publication in carefully written bulletins, all requires extreme care and accuracy and is a

valuable educational experience for any young man. This atmosphere of research, which they gradually absorb, becomes to them somewhat unconsciously prehaps, a mode of life.

Number of Persons on the Station Staff.- On July 1, 1910, the special research staff consisted of one assistant professor, one special investigator, two associates, four assistants, nine research graduate assistants, one assistant to the director, and one assistant editor. On July 1, 1940, the Station staff consisted of seven research professors, four research associate professors, seven research assistant professors, seven research associates, twelve research assistants, twenty research graduate assistants, one assistant to the director, and one draftsman.

C. PUBLICATIONS

General.- The Station has always maintained the policy of publishing accounts of its experiments as soon as they can be made available to the public so that those interested may have, at the earliest moment, the benefits of the experience and conclusions reached. In fact, one of the advantages of University research lies in the freedom with which it can distribute the unrestricted reports of its findings.

When the results of an investigational project are considered to be ready for publication, three copies of the manuscript are presented to the Director, and these are in turn, delivered to a special committee of three persons in theCollege of Engineering for examination and report as to quality, value, and form. The manuscript and the reports are then considered by the Station staff; and if satisfactory, the manuscript is ordered printed. All manuscripts are very carefully prepared typographically, literally, and technically, which is one reason for the high quality of the publications of the Station.

Most of the results of the experiments have been put out from time to time in the form of bulletins, 358 of which have been issued up to the end of 1945. These bulletins are composed largely of original materials developed from the observations made by the Station staff. The results of other investigations have been presented in the form of circulars, 50 of which have been published at the close of 1945.

Circulars contain, in addition to original information obtained by the research staff here, such other materials as are appropriate that have been provided by other agencies including federal and other state institutions, private corporations, and individual enterprise. Other publications issued by the Station are reprints of articles appearing in the technical press, but written by members of the University staff and others, on subjects appropriate for reproduction by the College of Engineering. Reprints were not authorized by the Station until 1931, since which time, 31 had been issued up to the end of 1945. Table XXVII shows the authorship of these publications by departments.

TABLE XXVII -DEPARTMENTAL AUTHORSHIP OF ENGINEERING EXPERIMENT STATION PUBLICATIONS[1]

Department	SINGLE DEPARTMENT			JOINT DEPARTMENT		
	Bulls.	Circs.	Reps.	Bulls.	Circs.	Reps.
Architecture	4					
Ceramic Engineering	18	3		2		
Civil Engineering	42	16	1	13		
Electrical Engineering	23	3		3		
General Engineering Drawing	1			1		
Mechanical Engineering	68	12	2	7		
Mining and Metallurgical Engineering	26	5	3	7		
Physics	14			4		
Railway Engineering	22	1				
Theoretical and Applied Mechanics and Municipal and Sanitary Engineering	82	2	19	10		
Chemical Engineering	33	8	6	2		
total	333	50	31	49		

Some of these publications represent investigations that have been carried on in entirely new fields of study; others represent studies that have served to

1. Includes Bulletin 358, Circular 50, and Reprint 31

broaden the areas of information in fields already established. All of them have had a part, then, in extending the body of engineering knowledge and in promoting a greater efficiency in industrial development. They have been distributed to nearly all the countries of the world and some of them have been translated into many foreign languages. They appear to have been as well received abroad as at home by the engineering profession, to have been generally regarded as authoritative in their particular lines, and to have been influential in extending the reputation of the College of Engineering. The results of the investigations have been republished in many of the leading engineering journals, both at home and abroad, and have been extensively quoted in various treatises dealing with subjects in engineering.

Because the investigations of the Station experimental work have extended over a period of years and have touched almost every phase of engineering enterprise, it is not possible because of obvious limitations in space, to describe in this publication in some detail any more than a few of the outstanding projects that are under way or that have been completed. These are considered in the following paragraphs.

a. The Ceramic Industries

General.- The experimentation by the University in the field of ceramics and ceramic engineering, has included a systematic study of the chemical and physical properties of the natural ceramic resources of the State for the purpose of ascertaining the possibilites of the development of new industries and the improvement of those already established. These experiments have been the means for providing much useful information to the manufacturers and users of ceramic products. Some of these studies are described briefly in the next few pages.

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Because the investigations of the Station organization have been directed over a period of years and have touched almost every phase of engineering, naturally, it is not possible because of obvious limitations of space, to describe in this publication in more detail any more than a few of the outstanding projects which are under way or which have been completed. These are summarized in the following paragraphs.

1. The Ceramic Laboratories

Ceramics. The investigations in the Laboratories in Engineering of ceramics and ceramic engineering has included a systematic study of the chemical and physical properties of the typical organic compounds of the State for the purpose of establishing the possibilities of the development of new industries and the improvement of those already established. These experiments have laid the basis for extensive work carried on subsequently in the manufacture and use of ceramic products. Some of these results are described briefly in the next few pages.

<u>Porcelains.</u>- An investigation under direction of Professor C. W. Parmelee relating to the translucency of porcelains, the results of which were recorded in Bulletin 154, provides valuable information regarding the characteristics of porcelain materials and recommends a special design of photo-electric cell as a convenient device for measuring the grades of translucency.

A report representing an investigation made by Professors C. W. Parmelee and J.O. Kraehenbuehl in cooperation with the Utilities Research Committee of Northern Illinois, on porcelain insulators, was published in Bulletin 273. The purpose of the study was to observe the relation and correlation between the electrical and mechanical properties of porcelain insulators furnished by manufacturers of high-voltage equipment and those of similar bodies produced under laboratory conditions.

<u>Clay Bodies.</u>- Because the resistance that clay bodies offer to thermal shock, or the impact resulting from quenching by water, air, or other means, is often used as a basis for comparisons of their physical-strength characteristics, it seemed appropriate to undertake a study of this subject. Consequently, a series of experiements were carried on by Mr. W. R. Morgan in cooperation with the Clay Products Association, that were summarized in Bulletin 229. These involved the measuring of the resistance that specimens offered to transverse breaking after the shock,-the most resistant being considered to be the one that showed the greatest transverse strength. The practical value of the work is that it provides a means for grading specimens that can serve as a criterion for designing resistant bodies and for controlling the plant during their manufacture.

Another set of investigations conducted by Mr. Morgan related to oxidation and loss of weight of clay bodies during firing. The experiments recorded in Bulletin 284, provide data showing the temperature intervals in which loss of weight occurs most rapidly and the correlation between loss of weight, water, carbon, and sulphur, and the oxidation properties of a large number of commercial clay bodies used in the manufacture of heavy clay products, thereby ascertaining the most advantageous temperature range for proper oxidation.

Refractory Materials.-Inasmuch as it became difficult to produce a commercial fire brick which would serve as a checkerbrick that could resist satisfactorily the rapid-changing cycles of temperature variations during the heating and cooling periods of kiln operation, "An Investigation of Checker Brick for Carburetors of Water-gas Machines" made at the Instance of the Public Utilities Companies of Northern Illinois under direction of Professor C.W.Parmelee, and published in Bulletin 179, was a timely contribution to provide data of great value to the utilities engaged in gas production, on the causes of failure of the checkerwork in carburetors of water-gas machines.

Another investigation ~~was~~ made under the direction of Professor Parmelee was in cooperation with The Consolidated Feldspar Corporation, the results of which were published in Bulletin 233. These studies on the nature and properties of 11 feldspars produced in different localities for use in the ceramic industries, serve to provide much useful information regarding the value of such materials in the production of pottery, glass, and enamel ware.

Still another of the experiments directed by Professor Parmelee related to a study of spinels,-a group of isomorphous minerals having great hardness and possessing such refractory and metallurgical properties that they are very useful in the ceramic industry. The results of these researches, published in Bulletin 248, provide much-needed data concerning the aluminates, chromites, andferrites of zinc, magnesium, iron, and manganese.

Circular 17, entitled "A Laboratory Furnace for Testing Resistance of Fire-Brick to Slag Erosion", by Prof. R. K. Hursh and Mr. C. E. Grigsby,is a report describing the slagging test-furnace developed here and the methods of conducting tests with the furnace.

Glass.- Experiments carried on under supervision of Professor C. W. Parmelee relating to glass and glass production, resulted in the publication of a number of bulletins. One of these, No. 271, deals with measurements of specific heats at high temperatures of some of the important types of commercial glasses when in the molten state. Another one, No. 311, relates to determinations of surface tension of molten glass. Both of these furnish valuable data useful to those engaged in the manufacture of glassware by the use of modern mechanical processes.

Vitreous Enamels.-Many investigations relating to enamels have been carried on under the direction of Professor A. I. Andrews. One of these reported in Bulletin 201, pertained to a study of acid-resisting cover enamels. Another, summarized in Bulletin 214, was concerned with the effects of certain furnace

gases on the properties of enamels. Still others were described in Bulletins 224 and 227. The first of these two deals with the effects of various gases present in the furnace during the smelting of enamels for sheet steel. The other discusses the effects of certain gases in smelter atmospheres on the quality of dry-process enamels burned on cast-iron bases. All of these studies provide valuable information useful to those engaged in enamel industries.

Glazes.- Bulletin 225 entitled "The Microstructure of some Porcelain Glazes", by Mr. Clyde L. Thompson, is the report of a systematic study of the microstructure of some porcelain glazes and of the influence of the microstructure upon the development of the glazes.

Gypsum Plasters.- "A Study of Hard-Finish Gypsum Plasters" by Mr. Thomas N. McVay, summarized in Bulletin 163, deals with the effect upon plasters of the addition of various salts, such as Glauber's salt, potash alum, and borax, and presents data useful to those interested in plasters and the building industry.

b. THE CHEMICAL-ENGINEERING INDUSTRIES

General.- The investigations carried on by this division of the Engineering Experiment Station include the chemistry of coal, ice production, embrittlement of boiler plate, boiler-water treatment, fractional distillation, catalytic processes, flue-gas treatment, and electro-organic chemistry. These are outlined briefly in the next few pages.

Coking of Coal.- Following the strike of the anthracite coal miners in Pennsylvania in 1902, the division of Industrial Chemistry under the direction of Professor S. W. Parr, began a series of active experiments having as their ultimate purpose the production of coke from Illinois Coal. The results of these investigations, summarized in Bulletins 24, 60, and 79, illustrate the processes of converting a low-grade bituminous coal, like the Illinois product having a high-sulphur content, into a smokeless fuel suitable for domestic use and at the same time adaptable to the ordinary household appliances found in common practice. The essential feature of Professor Parr's method is the low-temperature carbonization of coal

based on the carbonization of cannels. [illegible] have been described in Bulletins [illegible] and [illegible]. The first of these two deals with the effects of various gases present in the furnace during the [illegible] of [illegible]. The other discusses the effects of certain gases in [illegible] atmospheres on the quality of [illegible]. All of these studies provide valuable information useful to those engaged in several industries.

Cannels.- Bulletin [illegible] entitled "The Microstructure of Some Pennsylvania Cannels", by Dr. [illegible] Thiessen, is the report of a systematic study of the microstructure of some Pennsylvania cannels and of the influence of the microconstituents upon the [illegible] of the cannels.

Mineral Technology.- "A Study of [illegible]" by Mr. [illegible], summarized in Bulletin [illegible], deals with the [illegible] of the [illegible] of [illegible], [illegible], and [illegible], and presents data useful to those interested in [illegible] and its [illegible].

1. THE [illegible] DIVISION

General.- The investigations carried on by this division of the Engineering Experiment Station include the chemistry of coal, its production, [illegible] of [illegible], [illegible] products, [illegible] distillation, [illegible], the gas industry, and electrochemical processes. These are outlined briefly in the next few pages.

Coking of Coal.- Following the advice of the [illegible] coal [illegible] in [illegible] in 1926, the Division of Industrial Chemistry under the direction of Professor S. W. Parr, began a series of coking experiments having as their ultimate purpose the production of coke from Illinois coal. The results of these investigations, summarized in Bulletins [illegible], [illegible], and [illegible], illustrate the possibility of converting a low-grade bituminous coal, like the Illinois product having a high-sulphur content, into a [illegible] coke that [illegible] the [illegible] in the ordinary [illegible] found in [illegible] quantity. The essential features of Professor Parr's method in the low-temperature carbonization of coal

and the removal of the products of distillation as far as possible in their original state.

The experiments were carried on to the point where they demonstrated that it is possible to produce a smokeless fuel from Illinois coal suitable for domestic as well as industrial purposes. The advantage of this type of treament over other coking processes are: 1, by it, coke can be produced in a period of four hours where other methods require sixteen; 2, the Parr-process conserves the volatile elements, whereas many other methods waste them; and 3, the Parr method yields about double the amount of tar per ton of coal, a tar which is of higher grade than that obtained by high-temperature processes,-in brief, the method returns by-products that are worth more than the original cost of the fuel.

A side issue that developed from the production of coke by the Parr process resulted in the publication of the four bulletins on the subject of weathering and storage of coal discussed in the follwing paragraph.

Weathering and Storage of Coal.- The results of investigations made under the direction of Professor S. W. Parr on the weathering and storage properties of coal summarized in Bulletins 17,38,46, and 97, have proved to be of great value to the long list of mining, manufacturing, transpotation, utility, commercial, and individual interests using coal for power or heating purposes. They have outlined the fundamental principles that are necessary to be observed in the storage of coal in order to avoid spontaneous combustion, thereby benefitting the mine operators, the carriers, and the users by making it possible to put increased tonnage of coal in storage during the slack season of the summer months for use during the busy seasons of the other months. These studies show, also, the amount of deterioration and loss that may be expected during the storage period.

Other Studies in the Chemistry of Coal.- Another series of publications resulting from the study of the coking of coal, by Professor Parr, included Bulletin 32, "The Occluded Gases in Coal"; Bulletin 37, "Unit Coal and the Composition of Coal Ash"; Bulletin 76, "The Analysis of Coal with Phenol as a Solvent"; and Bulletin 111,

"A Study of the Forms in which Sulphur Occurs in Coal."

Alloys.- Experiments carried on by Professor S. W. Parr led to the discovery of an alloy of nickel that possessed remarkable acid-resisting qualities. This alloy, compounded principally of nickel and chromium with small percentages of copper, molybdenum, tungsten, aluminum, silicon, magnese, and iron, was named "Illium" in honor of the State of Illinois. The cast metal has a tensile strength of about 50,000 pounds a square inch, and the melting point of the alloy is about 2,400 degrees F.

Bulletin 93 by Mr. D. F. McFarland and Mr. O. E. Harder, presents the results of a study of the acid-resisting properties of chromium, copper, and nickel. The publication describes the methods which were developed for making castings of those alloys and shows photomicrographs of the structure of 21 binary and 30 ternary alloys which were prepared. The report also gives the results of physical and chemical tests of these alloys and describes the effect of acids as determined in about 300 corrosion tests.

The Chemistry of Ice Production.-Investigations regarding the chemistry of ice production undertaken by Mr. Dana Burks, Jr., in cooperation with the Utilities Research Commission, Inc., resulted in the publication of three bulletins, Nos. 219, 253, and 254. These studies showed conclusively that not only is it possible to produce clear, solid, marketable ice from any given natural or industrial water supply by proper chemical treatment, but also that it is possible to do so at a low brine temperature, thereby increasing the output at a lower unit cost. Practically all of the progressive ice producers in the country make use of the results of these tests to increase the efficiency and to improve the product of their plants.

Embrittlement of Boiler Plate.-Studies were begun in 1912 by Professor S. W. Parr on the action of boiler feed waters upon the embrittling processes of boiler plate. Bulletin 94 containing a report of the examination, presents the situation existing due to water conditions in the University and other districts in the State and describes the embrittling action of certain caustic solutions on steel and the laboratory experiments conducted to relieve the situation here. The remedies

"A Study of the Forms in which Sulphur Occurs in Steel."

Illium.—Experiments carried on by Professor S. W. Parr led to the discovery of an alloy of metals that possessed remarkable acid-resisting qualities. This alloy, composed principally of nickel and chromium with small percentages of copper, molybdenum, tungsten, aluminum, silicon, manganese, and iron, was named "Illium" in honor of the State of Illinois. The cast metal has a tensile strength of about 70,000 pounds a square inch, and the melting point of the alloy is about 1,300 degrees C.

Bulletin 93 by Mr. D. F. McFarland and Mr. O. E. Harder, presents the results of a study of the acid-resisting properties of aluminum, copper, and nickel. The publication describes the methods which were developed for making castings of these alloys and [illegible] properties of the properties of 50 binary and 50 ternary alloys which were prepared. The present time gives the results of physical and chemical tests of these alloys and describes the effect of acids as determined in which the corrosive tests.

The Chemistry of the Production.—Investigations concerning the chemistry of the production [illegible] undertaken by Mr. [illegible], in cooperation with the Illinois [illegible] Commission, [illegible], resulted in the publication of three bulletins, Nos. [illegible], [illegible] and [illegible]. These studies showed conclusively that not only is it possible to produce [illegible], [illegible] from any given natural or industrial water, [illegible] to proper chemical treatment, but also that it is possible to do so at a [illegible]. Their importance, [illegible], [illegible] the [illegible] of [illegible] practically all of the [illegible] in this country [illegible] of the [illegible] of [illegible] to [illegible] the [illegible] and to improve the product of these [illegible].

Embrittlement of Boiler Plate.—Studies were begun in 1913 by Professor S. W. Parr on the action of boiler fluid waters on the embrittling processes of boiler steels. Bulletin 94, containing a report of the investigation, presents the [illegible] [illegible] in water conditions in the laboratory and other [illegible] in the field, and describes the embrittling action of certain caustic solutions on steel, and the laboratory experiments conducted to [illegible] the [illegible] [illegible]. The results

suggested include the addition of a certain salt having properties which cause it to react with the alkali yielding a harmless product.

Other investigations were carried on from time to time on the embrittlement of boiler plate because of the persistent increase in the number of failures due to higher pressures, increased rates of heat transfer, and more extensive operation, and because of the demands for greater safety. The results of studies made by Professors S. W. Parr and F. G. Straub, in cooperation with the Utilities Research Commission, Inc., and published in Bulletins 155, 177, and 216, show that it is possible to reduce very substantially the embrittling effect caused by certain feed waters by the introduction of acid compounds.

Boiler-Water Treatment.-The cause and prevention of calcium-sulphate scale was made the subject of a set of investigations conducted by Professor F. G. Straub in cooperation with The Utilities Research Commission, Inc., the results of which were reported in Bulletin 261. The investigations proved conclusively that it is possible to use small quantities of sodium carbonate to prevent the deposit of calcium-sulphate scale in high-pressure boilers.

Another series of tests was undertaken by Professor Straub in cooperation with The National Aluminate Corporation on methods of treatment of boiler feed water by the use of salts including both inorganic and organic compounds to prevent deposits of various types of scale in boilers and on the blades of turbines.

The results of these studies have been of immense value to the utilities, for they have literally saved immense sums of money by providing the means for securing greater efficiency and economy in operation.

Fractional Distillation.-For a number of years Professor D. B. Keyes had directed research efforts in the field of distillation. Circular 35 presents a study of the factors involved in plate efficiencies for fractioning columns. Another report on fractional distillation is summarized in Bulletin 328, dealing especially with the ethyl alcohol-water system. The work of Professor Keyes and his associates has developed very valuable information for the use of those interested in the mechanics and chemistry of distillation.

The Catalytic Oxidation of Ethyl Alcohol.-Bulletin 238 entitled "The Catalytic Partial Oxidation of Ethyl Alcohol", By Professor Donald B. Keyes and Mr. Robert D. Snow, presents the results of a catalytic study, using approximately one hundred fifty catalysts, of the air oxidation of ethyl alcohol in the liquid phase, to prove that it is possible to oxidize partially ethyl alcohol to acetaldhyde.

Unit Operations.-Circular 34 entitled "The Chemical Engineering Unit Process-Oxidation", by Professor Donald B. Keyes, presents a discussion of the apparatus and methods employed in the commercial oxidation of sulphur, ammonia, and various organic compounds, for the production of sulphuric acid, nitric acid, alcohol, aldehydes, and other products.

Flue-Gas Treatment.-For a number of years Professor H. F. Johnstone has been engaged in carrying on and directing investigations, some of them in cooperation with the Utilities Research Commission, Inc., on the subject of treatment of boiler furnace gases to obviate some of the difficulties occasioned by such gases, especially sulphur dioxide. In Bulletins 228, 324, and 330, Professor Johnstone and his associates have discussed some of the problems caused by flue gases and have presented several excellent methods of affording relief from the action of gases resulting from the burning of high-sulphur coal.

Hydroxylation of Double Bonds.--"The Hydroxylation of Double Bonds," the topic of Bulletin 204 by Professor Sherlock Swann, Jr., presents a study of substitutes for sodium hypochlorite and the application of the best substitute to the hydroxylation of double bonds.

Electro-Organic Chemistry.--Bulletin 206 entitled "Studies in the ELectro-deposition of Metals," by Professors Donald B. Keyes and Sherlock Swann, Jr., contains the report of a study of the possibilities of the electro-deposition of a number of uncommon metals, such as aluminum, beryllium, boron, chromium, tungsten, titanium, vanadium, and cerium.

Other studies carried on by Professor Swann and summarized in Bulletin 236, were concerned with the influence of the cathode material on the electrolytic reduction of a typical aromatic ketone, benzophenone,-in acid solution, and with

The Catalytic [illegible] of Ethyl Alcohol.—Bulletin [illegible] entitled "The Catalytic Partial Oxidation of Ethyl Alcohol", by Professor Donald B. Keyes and Mr. [illegible] [illegible], presents the results of a [illegible] [illegible] [illegible] experimentally with [illegible] catalysts, of the six reactions of ethyl alcohol in the vapor phase, and shows that it is possible to [illegible] partially ethyl alcohol to acetaldehyde.

[illegible].—Bulletin [illegible] entitled "The [illegible] [illegible] [illegible] [illegible]", by Professor Donald B. Keyes, presents a discussion of the equipment and methods employed in the commercial [illegible] of [illegible], ammonia, and organic compounds, for the production of [illegible] [illegible] [illegible] alcohol, aldehydes, and other products.

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[illegible].—"The [illegible] of [illegible]", the title of Bulletin [illegible] by Professor [illegible] [illegible], presents a study of [illegible] [illegible] [illegible] and the application of the [illegible] [illegible] to the [illegible] of [illegible] [illegible].

[illegible].—Bulletin [illegible] entitled "Studies in the [illegible] of [illegible]," by Professor Donald B. Keyes and [illegible] [illegible], presents the report of a study of the possibilities of the [illegible] of a number of [illegible] [illegible] such as [illegible], [illegible], [illegible], [illegible], [illegible], [illegible], and [illegible].

Other [illegible] [illegible] [illegible] by [illegible] [illegible] and [illegible] in [illegible] [illegible], were concerned with the [illegible] of the [illegible] [illegible] [illegible] [illegible] of a typical [illegible] [illegible], [illegible], [illegible], and [illegible]

the development of additional information on the mechanism of reduction. The results of these investigations have been extensively applied both in this country and abroad.

c. CONCRETE AND REINFORCED CONCRETE

General Observations.- The contributions of the Station represented by the long list of publications dealing with investigations of concrete and reinforced-concrete construction have had a far-reaching influence in the formulation of safe and sane principles and practices in engineering construction, and have been of immense value to the industries, the State, and the Nation, by improving the efficiency of such construction materials where employed in the production of buildings, bridges, highways, and other forms of engineering construction. Some of these researches are described in some detail in the following pages.

Fundamentals of Cnncrete and Reinforced-Concrete Construction.-The first bulletin issued by the station,-September, 1904,-was written by Professor A. N. Talbot, and dealt with "Tests of Reinforced-Concrete Beams." In fact, the history of reinforced concrete almost parallels the history of the Engineering Experiment Station at the University of Illinois. Professor Talbot was author also of the next of this kind "Tests of Reinforced-Concrete Beams, Series of 1905". These publications presented data that were pioneers in formulating the theory of this type of reinforced-concrete construction. These were followed by others written by Professor Talbot that concerned tests for shear and bond in concrete, and tests of plain and T-beams, columns, and wall and column footings.

Bulletin No. 137 written in 1923 by Professor Talbot and Professor F. E. Richart on "The Stength of Concrete", presents a clear exposition of the theory and practice of forming concrete mixtures for different purposes that has done much to clarify and standardize the practice of concrete construction.

The reputation of the Station for research in reinforced concrete has induced several foreign students to come to the University to study that subject. It is interesting to note that one of these, Mikishi Abe, a man who had had several years experience as a Japanese government engineer and who had taught several years in

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Newspaper Union Building," a structure erected in Chicago in 1908, was made by Professors Talbot and H. F. Gonnerman in 1918, the results of which were published in Bulletin 106. The studies provided an unusual opportunity to impose excessive loadings[1] on a four-way reinforced flat-slab floor, far beyond the usual range of safety on a building, for the structure was soon to be razed to make place for the new Union Station Building, and to determine the resulting over-load stresses in the reinforcing steel and in the upper and lower surfaces of the slab. The investigation was followed closely by the engineering profession, and the results provided valuable contributions to the knowledge of design of reinforced-concrete slabs.

Reinforced-Concrete Slabs and Bridges.--A series of investigations undertaken in 1936 in cooperation with the U. S. Bureau of Public Roads, later designated as the Public Roads Administration, Federal Works Agency, and the Illinois Division of Highways, resulted in the publication of seven bulletins. Four of these, Nos. 303, 315, 332, and 345, all analytical, were written by Dr. Vernon P. Jensen. The first of the three deals with solutions involving rectangular slabs continuous over flexible supports. The second is concerned with moments in simple-span bridge slabs with stiffened edges. In the analysis, the span was limited to a theoretical maximum of thirty feet. The third gives consideration to a method of procedure for the analysis of stresses in skew slabs with curbs,-an opportune subject because of the more rigid restrictions found in highway construction due to limited space and clearances. In the last of the four, the author formulates a theory sufficiently complete to predict the ultimate strength of rectangular beams, reinforced in tension only and loaded so as to undergo a constant maximum moment over a portion of the beams,-an analysis that serves to provide the research worker with a better understanding of the fundamental behaviour of the reinforced-concrete beam.

Bulletin 304, written by Dr. Nathan M. Newmark, also analytical, deals with a discussion of the distribution procedure for the analysis of slabs continuous over flexible beams. The analysis is applicable to any rectangular slab simply supported on two opposite edges, with any manner of support on the other two edges, and con-

1. 913 pounds a square foot.

tinuous over any number and spacings of flexible simple beams transverse to the simply-supported edges.

One set of experiments, published in Bulletin 314, by Professor F. E. Richart and Mr. Ralph W. Kluge, pertained to tests of reinforced-concrete slabs subjected to concentrated loads. One purpose was a comparison of measured and computed stresses, and another purpose was to determine the effect of the size and shape of the bearing area over which the load was applied. For this study, the loads were applied through rings, circular discs, and pairs of discs of various sizes and arrangements.

Bulletin 346, written by Professor V. P. Jensen, Mr. R. W. Kluge, and Mr. C. B. Williams, Jr.,which supplements the analytical studies reported in Bulletin 315, describes the laboratory tests made on seven quarter-scale and two half-scale models of highway bridge slabs with curbs, and presents a simplified method of design sufficiently comprehensive in scope to include bridges with unlike curbs and spans up to 45 feet.

Due to the increased use of single-span, rigid-frame bridges because of certain advantages they possess, it seemed advisable to obtain a better understanding of their characteristics and possibilities. Accordingly, a series of investigations was made in cooperation with The Portland Cement Association, the results of which were published in three parts. Part I, Bulletin 307, under direction of Professors F. E. Richart and T. J. Dolan, gives consideration to tests of reinforced-concrete knee frames and of Bakelite models of rigid-frame bridges. Part II, Bulletin 308, under direction of Professor W. M. Wilson and Mr. Ralph W. Kluge, is concerned with laboratory experiments of reinforced-concrete rigid-frame bridges. Part III, Bulletin 322, by Mr. Ralph W. Kluge, pertains to tests of structural hinges of reinforced concrete. The work consisted in obtaining information relative to the structural behavior of various types of hinges adaptable to reinforced-concrete rigid-frame bridges.

<u>Reinforced-Concrete Arches</u>.-In November 1923, there was begun a series of tests on reinforced-concrete arches under the immediate supervision of Professor W. M.

Wilson as a part of the research program sponsored by the Committee on Concrete and Reinforced Concrete of the American Society of Civil Engineers that developed into the most comprehensive set of investigations ever to be undertaken in this field. The first of the studies summarized in Bulletin 174, compares the theoretical changes in a multiple-span arch due to temperature variations, with the measured changes. The secnnd, published in Bulletin 202, concerns comparisons of theoretical and measured stresses due both to loadings and abutment movements. A study of the behavior of arches with decks is described in Bulletin 226, while observations made on five multiple-span arch bridges in service to determine the amount of movement of piers during the construction period and their effects on the stresses developed, are epitomized in Bulletin 234. Further laboratory tests of three-span arch ribs on slender piers and with decks on slender piers, carried on in cooperation with the U. S. Bureau of Public Roads and a number of other contributing organizations, and summarized in Bulletins 269 and 270, were made to study the performance of multiple-span arches under ordinary and destructive loadings. Additional investigations made also in cooperation with the U. S. Bureau of Public Roads and other agencies, and summarized in Bulletin 275, present the effects of changes due to shrinkage, time-yield, and temperature on the stresses imposed.

Bulletin 203 written by Professor Hardy Cross represents a mathematical analysis of the effects on the moments and thrusts resulting from distortions in arches.

All of these observations, analyses, and experiments have supplied vital materials that have contributed much towards the sum-total knowledge regarding the principles of design and construction of reinforced-concrete arches.

d. OTHER ENGINEERING MATERIALS AND ENGINEERING STRUCTURES

General.-Most of the investigations undertaken, outside of concrete, in the fields of engineering materials and engineering structures have been with metals and fabrications of metals, principly steel, although a few have been with wodd, brick, stone, sand, gravel, and bituminous mixtures.

The severe uses made of carbon and alloy steels in engineering practice, as for example in automobile and airplane construction, have developed a need for more

the Imperial University of Tokyo, conducted under the direction of Professor Talbot, an elaborate series of "Tests and Analyses of Rigidly-connected Reinforced-Concrete Frames," the results of which were summarized in Bulletin 107, that led to his constructing in Tokyo of a reinforced-concrete elevated railway structure, the first of its kind in the world.

Haydite Concrete.-In order to provide information on the suitabilitydof Haydite, (a material obtained by burning shale in a rotary kiln to the point of incipient fusion, when it expands into a light-weight clinker), as coarse aggregate in the construction of a light-weight concrete that could meet the requirements of strength and that would be adaptable to the construction of long-span bridges where the item of weight is a matter of serious consideration, a number of experiments were carried on under the direction of Professor F. E. Richart in cooperation with the Western Brick Company. The results, summarized in Bulletin 237, present data on the strength of the material itself and of concrete with it as an aggregate to show that it is possible to construct concrete structures with the material at a substantial saving in cost.

Reinforced-Concrete Building Construction.-Bulletin 64, entitled "Tests of Reinforced-Concrete Buildings under Load", describes the methods that were developed by the authors,-Professors A. N. Talbot and W. A. Slater,-for testing buildings to determine the action of their various parts under load. The records cover investigations on three buildings, with discussions bearing on the findings. These tests were the first known to be made on reinforced-concrete buildings.

Investigations involving "Tests of Reinforced-Concrete Flat Slab Structures", also by Professors Talbot and Slater, published in Bulletin 84, were made on four reinforced-concrete buildings and one reinforced-concrete test structure,-all of the flat-slab type of construction. These tests, providing important information regarding this type of building construction, were valuable in formulating regulations covering the design of such structures. The publication very forcibly calls attention to the bending produced in columns in buildings of this kind.

A noteworthy piece of research, "Tests of a Flat Slab Floor of the Western

the Imperial University of Tokyo, conducted under the direction of Professor Naito, an elaborate series of "Tests and Analyses of Rigidly-connected Rectangular-frame Towers;" the results of which were presented in Bulletin 197, have led to his construction in Tokyo of a reinforced-concrete [illegible] tower, the first of its kind in the world.

Haydite Concrete.--In order to provide information on the [illegible] (a material obtained by heating shale in a rotary kiln to the point of incipient fusion, when it expands into a light-weight clinker), as coarse aggregate in the manufacture of a light-weight concrete that would meet the requirements of strength and that would be adaptable to the construction of long-span bridges where the item of weight is a matter of serious consideration, a series of experiments were carried on under the direction of Professor F. E. Richart in cooperation with the Western Brick Company. The results, summarized in Bulletin 237, present data on the strength of the material itself and of concrete using it as an aggregate to show that it is possible to produce strong concrete with the material if it is properly used.

Reinforced-Concrete Building Construction.--Bulletin 64, entitled "Tests of Reinforced-Concrete Buildings under Load", presents the methods that were developed by the authors, Professors A. N. Talbot and W. A. Slater, for testing buildings to determine the action of heavily-loaded [illegible] under load. The results of these investigations on eleven buildings, were illustrated [illegible] in the bulletin. These tests were the first known to be made on reinforced-concrete buildings.

Investigations involving "Tests of Reinforced-Concrete Flat Slab Structures", made by Professors Talbot and Slater, published in Bulletin 84, were made on four reinforced-concrete buildings and one reinforced-concrete test structure, all of the flat-slab type of construction. These tests, providing important information regarding this type of building construction, were valuable in formulating regulations covering the design of such structures. The publication [illegible] attention to the bending produced in columns in buildings of this kind.

A noteworthy piece of research, "Tests of a Flat Slab Floor of the Western

detailed knowledge of the action of steel, under various types of stress, as well as of the factors which affect the physical properties of the material. Some of the work done along this line at the University here is described briefly in the following pages.

Steel and Steel Shapes.--Because of the prevalent practice of using I-beams as flexural members, the subject of flexural strength became of such general engineering interest that it seemed to be an appropriate topic for investigation in order to reconcile theory with practice in I-beam design. Consequently, a number of observations were made and reported in Bulletin 68 by Professor H. F. Moore. The publication includes data developed on the strength of standard I-beams in flexure and presents a formula for computing the flexural strength of I-beams acting as columns. The information was especially welcomed by engineers at that time, because of the failures of I-beams in some buildings in the Chicago area and because of the different and somewhat conflicting opinions that were held on the strength of such materials.

The results of an investigation made to determine the relations betwenn the elastic strength of steel in tension, compression, and shear, were summarized in Bulletin 115 by Professors F. B. Seely and W. J. Putnam. Six grades of steel were used in making the tests. Additional investigations on such materials as I-beams, channels, and other similar shapes, served to develop information regarding their adaptability to engineering purposes.

Steel Structures.-The first bulletin issued by the Station on structural steel was No. 16, written By Professor N. C. Ricker in 1907 on the subject of roof trusses. The publication had as its purpose the presentation of a rational formula with supporting data for computing the weights of roof trusses,-wood as well as steel. The next one on this subject, No. 35, also by Professor Ricker, related to the development of a formula for computing the sizes and bearing values of base and bearing plates for beams and columns.

Investigations on the behavior of built-up columns under load, summarized in Bulletin 44 by Professors A. N. Talbot and H. F. Moore, included both laboratory

and field tests,-a railway train made of a locomotive and cars formed the load for the field tests. The studies were undertaken to show the distribution of the stresses through the members of the column and the relationships between these members and the column as a whole.

Two sets of tests on riveted joints in steel members,-one on nickel-steel joints and the other on chrome-nickel-steel joints,-were made by Professors Talbot and Moore at the expressed invitation of those responsible for the construction of the Quebec bridge scheduled to replace the one that collapsed in 1907. The investigations, summarized in Bulletin 49, dealt with a variety of tests of rivets to determine the strength of rivets and the extent of the deformation of the joints and slip of plates.

Studies carried on under the direction of Professor W. M. Wilson to measure the wind stresses in the steel frames of a number of tall office buildings were recorded in Bulletin 80. The results of these investigations have served as a basis for revising the units used in designing such structures. Other studies by Professors W. M. Wilson and H. F. Moore were made to examine the rigidity of riveted joints in steel structures, such as the steel skeletons of office buildings. Bulletin 104 describes the tests and testing machines used and presents an analysis of the results including the effect of slip of the members on the distribution of stresses in test specimens.

Bulletin 108 presents the slope-deflection method developed by Professors W. M. Wilson, F. E. Richart, and others, that has been used extensively by practising engineers for computing stresses in statically-indeterminate structures that ordinarily do not lend themselves to critical mathematical analysis. The publication constitutes a treatise in this particular field that places such structures within the range of scientific examination. The bulletin concludes with a section that presents the solutions of a number of examples to illustrate the use of the formulas.

Investigations reviewed in Bulletin 210 by Professors W. M. Wilson and W. A. Oliver on the subject of strength of rivets in tension and the initial tension in

rivets used in fabricating structural steel, proved the fallacy of opinions held by many engineers that designers should not consider the tension in rivets in computing the capacity of fabricated steel.

Two bulletins by Professor W. M. Wilson,-No. 162, on the bearing value of large-radius segmental rollers, and No. 191 on the flow of metal in plates,- provided data that were used as a basis in formulating specifications that have been widely adopted for the design of segmental rollers and bearing plates in rolling bascule bridges. Other studies by Professor Wilson summarized in Bulletin 263, pertained to the load-carrying capacity of small rollers like those employed as expansion rollers and rockers of girder and truss bridges. The investigations included both static and rolling tests with various grades of steel and steel castings.

Another set of tests carried on under the direction of Professor Wilson in cooperation with the Chicago Bridge and Iron Works,was made to investigate the efficiency of various types of joints in wide plates, such as those employed in the fabrication of tanks used for storage of water and oil. The results, summarized in Bulletin 239, present data obtained from examination of a number of welded and riveted joints that are commonly used in tank construction.

Interest in the strength of thin cylindrical shells as they are commonly used in the construction of elevated storage tanks led to a study of this type of structure by Professor Wilson in cooperation with the Chicago Bridge & Iron Works. The immediate purpose of the investigations was concerned with geometrical proportions of the cylinder such as length, thickness, radius, and end conditions, and the resistance of the material to failure by wrinkling. The results were published in Bulletins 255 and 292. Bulletin 292 includes, in addition, tests made on laced channels and angles acting as columns. Another investigation carried out under the direction of Professor Wilson was in cooperation with the Nickel Plate Railroad Company, on the effect of residual stresses occasioned by the heating and cooling processes involved in welding steel plates or shapes to members of a bridge already in place in order to strengthen the structure for the modern heavy wheel

loads, on the load-carrying capacity of steel columns. The results of the tests conducted at the University and on the Girard, Pennsylvania, viaduct, are recorded in Bulletin 280.

Foundations.-Bulletin 338 entitled, "Influence Charts for Computation of Stresses in Elastic Foundations", by Professor Nathan M. Newmark, presents a simple graphical procedure for computing stresses in the interior of an elastic, homogeneous, isotropic solid bounded by a plane surface and loaded by distributed vertical loads at the surface. The stresses are computed from charts supplied with the publication, merely by counting on a chart the number of elements of area, or blocks, covered by a plan of the loaded area drawn to proper scale and laid upon the chart.

Timber Beams.-A series of "Tests of Timber Beams", made under direction of ProfessorA. N. Talbot in cooperation with two midwestern railway companies, and described in Bulletin 41, was conducted on railroad bridge timbers to determine the strength of such timbers and the properties of test pieces cut from various portions of a large stock. The tests were important in establishing unit values for use in bridge design and in observing the significance of shear resistance in timbers of large size and also of the weakening effect of seasoning cracks which form in such timbers.

Culvert Pipe.A unique set of tests, summarized in Bulletin 22, was conducted on both cast-iron and culvert pipe under the direction of Professor A. N. Talbot in cooperation with four midwestern railway companies. The pipes were 36 and 48 inches in diameter and 8 feet or more in length. In conducting the tests, the pipes were encased in sand in a strong timber box made of railway bridge stringers held together by large iron rods. The loads were applied through a saddle which enabled the pressure to be distributed over the sand around the pipe. Four hydraulic jacks having a total capacity of 800,000 pounds were used to apply the pressure and measure the load.

Miscellaneous.-Bulletin 215 by Professor Hardy Cross on the subject of "The Column Analogy", presents a general mathematical discussion of the mechanics of structures that very materially simplifies the processes of analyzing stresses in continuous

frames composed of haunched beams, arches, or framed bents, as well as in simple spans. It demonstrates that moments, shears, slopes, and deflections of beams due to any cause may be computed in the same way and by the same formulas that are used in calculating reactions on short columns eccentrically loaded or that are used in determining shears and bending moments on longitudinal sections through such columns.

e. FATIGUE OF METALS

Definition.-Fatigue of metals is defined as "the action which takes place in metal, causing failure after a large number of applications of stress. Failures due to fatigue are characterized by their suddenness, and by the absence of general deformation in the piece that fails." - Bulletin 124, Eng. Exp. Sta., page 162.

General Investigations on the Fatigue of Metals.-The immediate need for the study of the fatigue of metals developed with the coming of new alloys and stronger metals and with the advent of high-speed machinery, some parts of which must be as light as possible, as for example, the connecting rods of gas engines and the shafts of steam turbines, where members are required to withstand an indefinitely large number of repetitions of loads with reversals of stress within a comparatively short period of time. This problem, of prime importance during World War I in the construction and operation of airplanes and a little later in the construction of welded ships, came to the attention of the National Research Council, with the result that a comprehensive program of investigation of the fatigue phenomena of metals was begun by the Engineering Experiment Station at the University of Illinois in 1919 under the direction of Professor H. F. Moore that have continued in one form or another under his immediate supervision to the present time. The first four bulletins, Nos. 124, 136, 142, and 152, having the title "An Investigation of the Fatigue of Metals", were prepared in cooperation with the National Research Council, the Engineering Foundation, the General Electric Company, the Allis-Chalmers Manufacturing Company, the Copper and Brass Associtition, and the Western Electric Company to determine the endurance limit of stress of nineteen different metals in common use. Many of the tests were made under a number of different heat-treatments.

"Tests of Fatigue Strength of Cast Steel," a study of the fatigue strength

of cast steels of two different chemical compositions, made in cooperation with the American Steel Foundries and printed in Bulletin 156, and "Tests of the Fatigue Strength of Cast Iron," made in cooperation with the Allis-Chalmers Manufacturing Company and printed in Bulletin 164, have served to provide a much better understanding of the fatigue characteristics of these metals.

Bulletin 176 entitled "A Metallographic Study of the Path of Fatigue Failure in Copper," presents a study of the use of metallographic examinations as an aid in explaining the beginning and progress of a fatigue fracture in copper. "Tests of the Fatigue Strength of Steam Turbine Blade Shapes," made in cooperation with the Allis-Chalmers" Manufacturing Company, and published in Bulletin 183, were made on three different metals,-monel metal, a copper-nickel alloy known as cupro-nickel, and cyclops metal. These studies show that with care, steam-turbine blades may be expected to develop nearly all of the fatigue strength of the metal from which they are made.

Bulletin 208 records the results of "A Study of Slip Lines, Strain Lines, and Cracks in Metals under Repeated Stress," for seven different metals, some under specially heat-treated conditions.

Many of the machines made by members of the Station staff and used in conducting these experiments on the fatigue of metals, during the first fifteen years of the test period are described in Circular 23. A large percentage of the machines are of the simple rotating-beam and cantilever type designed to produce complete cycles of reversal of tensile and compression bending stresses. Other machines are constructed to produce cycles of direct tension and compression and torsion and shear.

The observations made in the laboratories in connection with these investigations on the fatigue of metals have been vitally important in developing a better understanding of the physical properties of metals and in leading to a new concept of the nature of metal structure by demonstrating the scientific fact that fatigue failures are due to the progressive spreading of fractures or actual microscopic cracks, and not to any peculiar crystallization of the particles of metal nor to

changes in the elastic limit of the material. It has demonstrated beyond doubt that scratches, nicks, grooves, and other irregularities of surface, and internal inclusions of extraneous materials or flaws, are possible sources of fatigue failure because of the highly-localized stresses they are likely to occasion,-stresses that are entirely neglected in the ordinary formulas dealing with the mechanics of materials. The investigations have value, too, in serving as a basis for the preparation of specifications defining the limiting ranges of unit stresses for various metals that are intended for the construction of machines that must operate through an indefinitely large number of repetitions or cycles of stress.

Fatigue in Railway Car Axles-"A Study of Fatigue Cracks in Car Axles," reported in Bulletins 165 and 197, and made in cooperation with The Utilities Research Commission of Northern Illinois, shows that it is possible to detect fatigue cracks before they spread to complete failure and that it is also possible to salvage car axles in which fatigue cracks occur, by turning them down to a smaller size. "A Study of the Stresses in Car Axles under Service Conditions" outlined in Bulletin 244, was carried out also in cooperation with the Commission in axles of a test car on the Chicago Rapid Transit System giving special emphasis to the type of axle; the magnitude, duration, and causes of the stress; and the number of cycles of stress per mile.

f. CREEP IN LEAD AND LEAD ALLOYS

Lead Sheathing.-In 1929, investigations under the general direction of Professor H. F. Moore were begun in cooperation with the Utilities Research Commission, Inc., on the subject of creep, or continuing deformation, and fracture in lead and lead alloy with tin, antimony, and calcium, as used in cable sheathing, for the particular purpose of determining the extent of stability of form and the amount of safety that could be expected of lead-sheathed cables under service conditions. The results of the investigations on test specimens, taken from service cables or supplied directly by the manufacturer and subjected to variations of sustained and repeated loadings over a wide range of time and other conditions, were published in Bulletins 243, 272, 306, and 347, providing valuable information to the manufacturer and user of lead

sheathing, especially as employed in the construction of power cables.

g. LAND DRAINAGE AND FLOOD CONTROL

Stream Flow.-Between 1924 and 1931 observations were carried out under the general supervision of Professor G. W. Pickles in cooperation with the U. S. Bureau of Public Roads to determine the area run-off and open-channel stream flow for regions in Central Illinois where most of the terrain is so flat as to require open artificial channels in addition to the natural water-courses to provide adequate drainage for successful crop production. Bulletin 232, summarizing the results of the investigations, provides useful information required in the design of suitable artificial channels to relieve the rainfall situation and in the determination of the amount of the annual run-off of small watersheds.

Flood Flow.-Another bulletin, No. 296, written by Professor Pickles, provides information concerning the magnitude and frequency of floods in twenty-four Illinois streams from data taken from records of stream flow over a period of about thirty-five years. These data, applying to drainage areas of 200 or more square miles in extent, serve as a basis for predicting the frequency of various ranges of flood flows in this region.

h. PRINCIPLES OF HYDRAULICS

General.-The hydraulic laboratory here has offered many opportunities for the development of knowledge relating to the laws or principles of hydraulics, which are fundamental in any consideration of water power, water supply, and drainage. A few of these are discussed briefly in the following paragraphs.

Flow and Measurement of Water.-The results of tests made by Professors A. N. Talbot and M. L. Enger on fourteen water columns representing the principal types employed in American railway practice for supplying water to steam locomotives, were summarized in Bulletin 48. The information developed in these tests enabled manufacturers to redesign their water columns, making them more efficient, thereby reducing the delay to locomotives and the cost of water service.

A study conducted by Professor F. B. Seely on the effect of mouthpieces on the flow of water through submerged short pipes, was described and discussed in Bulletin

96. The experiments were carried on both with and without entrance and discharge mouthpieces for comparisons. Another set of tests made under the supervision of Professor Talbot dealt with investigations with valves, orifices, hose and nozzles, and orifice buckets, as devices for measuring the flow of water.

The feasibility of measuring the flow of water by means of a thin plate circular orifice inserted in a pipe line is demonstrated by the results obtained by Professors R. E. Davis and H. H. Jordan as published in Bulletin 109. The publication provides experimental coefficients for calculating the velocity of flow in the pipe and the discharge, and depicts the conditions that are most favorable to the use of such orifices as flow-measuring devices. The practicability of using an elbow as a flowmeter in a pipe line for measuring the amount of liquid passing through the line, was demonstrated by Professor W. M. Lansford in his Bulletin 289.

The Hydraulic Ram.[1]The use of the hydraulic ram as a device for lifting water was the subject of additional experiments by Professor Lansford. The author, in Bulletin 326, described the conduct of the experiments and presented a rational mathematical analysis of the operation of single-acting automatic rams and compared the results obtained from such analyses with those found in the laboratory.

i. ENGINEERING SANITATION

General-Investigations in engineering sanitation carried on under direction of Professor H. E. Babbitt, have been extremely important in supplying information requisite to the scientific planning of plumbing and sewage-treatment systems. Some of these are described briefly in the following statements.

Hydraulics and Pneumatics of House Plumbing.-The results of tests reported in Bulletins 143 and 178 serve to supply information concerning the action of water and the accompanying air in house plumbing, especially in the soil stacks, water pipes, traps, and vent pipes, of one, two, and three-story residences. In order to carry on these experiments, a special plant was set up in the Mathews Avenue Power Plant. The information developed and the principles established from these investigations have been valuable in formulating designs of plumbing installations and in reducing the complications and cost of plumbing construction.

Sewage Disposal.-Investigations leading to the publication of Bulletin 198 were concerned with the development of basic principles in the case of tank methods of treatment of city sewage. Bulletin 268 presents data obtained to determine the efficiency of a certain form of paddle aerator and summarizes studies made by an aspirating device known as the "Aeromix" used in the course of sewage treatment.

Experiments pertaining to the discharge of ground garbage into sewage systems are described in Bulletin 287. Two other Bulletins, Nos. 319 and 323, relate to the hydraulics of the flow of sludge pumped through circular pipes. The first discusses laminar flow, or the flow parallel to the axis of the pipe, while the second describes turbulent flow, or the flow disturbed by cross currents. These two bulletins present formulas for computing the velocity of sludge-flow through pipes under various conditions, and for the determination of yield value and coefficient of rigidity of sludge. All of this information is essential to the design of pipe-sizes and pumping equipment for handling sludge through pipe-line systems.

j. THE ELECTRICAL INDUSTRIES

General.-The University of Illinois has made many important contributions to the knowledge of the principles underlying the science of electrical engineering. Its investigations have extended to studies of the magnetic properties of iron and iron alloys melted in a vacuum, electronics, radio and telephone communication, meter performance, illumination, high-potential circuits, and so on. Some of these are described briefly in the next few pages.

Iron and Iron Alloys Melted in a Vacuum.-One of the noteworthy investigations by Assistant Professor T. D. Yensen, - "Magnetic and other Properties of Electrolytic Iron Melted in Vacuo", published in Bulletin 72, led to the discovery in 1913 of a new process for the production of iron and iron alloys through the aid of an electric furnace, permitting the melting of iron in a vacuum and thereby developing metals that had electrical properties superior to those produced in other ways. These discoveries concerning the magnetic properties of electrolytic iron melted in a vacuum electric furnace attracted world-wide attention, and have been of great value in developing the manufacture of high-permeability iron and iron alloys and stand

among the most important additions to scientific knowledge ever made by the Department of Electrical Engineering at the University of Illinois, for these processes have been used extensively in the construction of certain telephone appliances and of many other forms of apparatus used in electrical construction. Bulletin 83, entitled "Magnetic and Other Properties of Iron-Silicon Alloys Melted in Vacuo", summarizes results from experiments on iron-silicon alloys that were continuations of those mentioned above. Further studies along this line, especially on iron-aluminum alloys, show that aluminum like silicon, improves the properties of the metal and also that aluminum imparts to the metal a greater toughness than silicon.

Electronics.-Early experiments carried on at the University of Illinois indicated that the introduction of certain gases into vacuum tubes improved to some extent the sensitivity of tubes as detectors and demodulators. In order to furnish additional information on this subject, Professors H. A. Brown and C. T. Knipp conducted further tests on the performance of vacuum tubes filled with alkali vapor and used as detectors, the results of which were published in Bulletin 138. In addition to describing these particular investigations, the bulletin describes briefly the previous experiments made on tubes containing nitrogen, neon, hydrogen, argon, and helium gases.

For a number of years, investigations were carried on at the University looking to the improvement of the photo-electric cell. Some of these are summarized in Bulletin 325 by Professors J. T. Tykociner, Jakob Kunz, and others. The work done in the laboratories of the University has had a major influence in the development and perfection of the photo-electric tube used so extensively in scientific and commercial practice throughout the world.

Sound in Motion Pictures.-Through laboratory experiments, Professor Tykociner was able to perfect and demonstrate the sound-on-film recording and reproducing method now universally employed to produce and synchronize sound in moving pictures. His method consisted in photographing the accompanying sound waves on the same film as that used for taking the motion picture itself. His camera carried in addition to the ususl apparatus for taking motion pictures, another photographic objective for

photographing on a narrow strip at the edge of the film, the sound record produced during the filming of the moving object. He designated the sound-recording equipment by the name of "phonactinion", which word expresses the manifold transformation of sound energy controlling actinic rays by means of a stream of ions. He developed another machine called the "actophone" for producing the motion pictures and sound from the same film. While the motion pictures were being projected on the screen, the loud-speaking device reproduced the synchronizing sounds.

Radio Communication.-The University of Illinois has had also a major share in the development of radio communication through the work carried on and directed by Professor J. T. Tykociner. Bulletin 147 contains a discussion of the theoretical considerations involved in the use of scale models of antennae for purposes of investigation of all the properties of radiating systems. The publication shows that by the use of micro-waves and inexpensive scale models, it is possible to save much time and expense in the erection of important radio stations, for laboratory tests made with micro-waves and models properly designed furnish data for predicting the performance of the finished station employing long-wave systems. Bulletin 161 summarizes the results of tests made on short-wave transmitters and methods of tuning, the principles developed then being still used as bases of today's short-wave transmitting systems. Another publication, Bulletin 194, relates to the tuning of oscillating circuits by plate-current variations. Still another publication, Bulletin 291, is concerned with studies made on the use of vibrating bars and plates cut from quartz crystals, for stabilizing high-frequency oscillators used in broadcasting,-devices to enable simultaneous radio transmission of a great number of stations and to keep them within reasonable limits of their allotted-frequency channels.

Bulletin 339, entitled "Properties and Applications of Phase-Shifted Rectified Sine Waves," also produced by Professor Tykociner, presents the results of an investigation made to analyze by graphical methods the properties of wave forms obtained by subtraction or addition of two phase-shifted rectified sine pulses, and to show that new wave forms are obtainable also by subtraction or addition of a full sine wave and a phase-shifted rectified sine wave. The publication substantiates

the graphical methods by a mathematical discussion and offers suggestions for the application of the properties of the new wave forms.

Telephone Communication.-Two bulletins, Nos. 145 and 148, by Professors H. A. Brown and C. A. Keener, relate to experiments in the field of telephone engineering. The first deals with fundamental principles of non-carrier radio telephone transmission, and points out the advantages of this method over those in use at that time. The second relates to the intensity or degree of modulation obtainable with representative types of radiophones in use and also with these types modified. Both of these publications have provided information for individuals interested in this particular phase of public-utility service.

Meter Performance.-Many investigations have been carried on in the University laboratories pertaining to the performance of meters as registering devices for electric power. Studies outlined in Bulletin 153 by Professors A. R. Knight and M. A. Faucett relate chiefly to experiments made with singlephase meters used in recording current consumption for household purposes.

Illumination.- The results of an extensive investigation directed by Professor J. O. Kraehenbuehl and carried out at the request of the Industrial and School-Lighting Committee of the Illuminating Engineering Society, of studylighting conditions in the student living quarters at the University of Illinois, are summarized in Circular 28. The effect of this particular study was a general improvement in lighting conditions in the student-study and rooming places on the campus and in the adjoining community.

Some problems in the field of public-building illumination were taken up by Professor Kraehenbuehl in Circular 29. The publication deals with the general principles that underlie the necessity for good lighting and the problems involved in producing good-lighting conditions.

High-Potential Circuits.-Observations under the direction of Professor Jakob Kunz, covering a period of several years, carried on to formulate a satisfactory theory of corona phenomena, were reviewed in Bulletin 114. Corona discharges represent a very substantial loss of power especially noticeable in long high-pressure transmission

lines. Another set of studies made and supervised by Professors J. T. Tykociner and E. B. Paine, and others, and published in Bulletin 278, dealt with oscillations due to corona discharges on wires subjected to alternating potentials of different frequencies.

Additional experiments relating to high-pressure circuits were concerned with methods of testing the insulating materials in high-tension cables. These investigations made by Professors J. T. Tykocinor, H. A. Brown, and E. B. Paine, in cooperation with the Utilities Research Committee, were carried on in part at the laboratories of the University and in part at the high-tension laboratories of the Commonwealth Edison Company at Chicago. Two bulletins, Nos. 259 and 260, were published describing the experiments. The first treats of the developments of methods of detecting and measuring oscillations due to ionization in dialectrics, and the second, of the investigation of ionization in cable insulation by means of the Discharge Detection Bridge, a piece of apparatus evolved in connection with this experiment.

The Electron Theory of Magnetism.-Bulletin 62 by Professor E. H. Williams, presents a summary of the essential features of the electron theory of magnetism and provides experimental evidence to support the theory. It also includes an analysis of some of the phenomena for which the theory as previously maintained, had failed to give a satisfactory explanation.

Analysis of Flow in Networks of Conductors or Conduits.-An analytical discussion of the behavior and distribution of flow in networks of such conductors as electric transmission lines delivering power or of such conduit systems as pipes delivering water, steam, gas, air, or other substance under pressure, is presented by Professor Hardy Cross in Bulletin 286. The method outlined includes a series of approximations and corrections, with many mathematical examples to illustrate the principles involved.

A further discussion of the subject of networks as applied to electrical transmission-line hook-up, is presented by Professor L. L. Smith in Bulletin 299. The author describes in some detail the methods available for the analysis involving

such networks, and presents an analysis for balancing the voltage and current drops by the use of successive approximations as devloped by Professor Cross, with the solutions of a number of cases to demonstrate the methods.

k. THE COAL-MINING INDUSTRY

General.-Because of the importance of the coal-mining industry to the State, the University has given special consideration to problems involved in the mining, preparation, and utilization of coal; and in doing so has rendered valuable assistance to all those who mine, handle, or use coal in any way. Some of the investigations are described briefly in the following statements.

Coal-Mine Operation.-Bulletin 88 by Professor E. A. Holbrook, presents a comprehensive report made from a study of a thirty-five year record on the dry preparation of bituminous coal at Illinois mines, including screening, weighing, drycleaning and loading. The publication presents a discussion of a number of subjects,among which are past and present practices of coal preparation, standard types of tipples used in Illinois mines, impurities in coal, breakage of coal during mining operations and transit, and sizes and sizing of Illinois coals and the needsfor standardizing outputs.

The matter of subsidence of surface ground due to underground mining operations was made the subject of extensive observation by Professors L. E. Young and H. H. Stoek, the results of whose findings were published in Bulletin 91. This topic is especially important in Illinois because of the extent of mine operations, the growth of towns and cities and transportation lines, and the increased value of overlying surface land.

An investigation concerning the percentage of extraction of bituminous coal from mines, made by Professor C. M. Young, was summarized in Bulletin 100. The studies had the effect of increasing the percentage of extraction of coal, thereby reducing the loss due to coal being left in the ground and therefore wasted.

An examination of underground haulage of coal involved in the processes of mining operations was made in a particular study directed by Professor H. H. Stoek, the results of which were published in Bulletin 132. This is a problem of special

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interest to Illinois operators because of the great distances involved in underground transportation.

In order to increase the efficiency of mine operation and to decrease the cost of elevating and conveying coal from the mines, Professor A. J. Hoskin in cooperation with the Illinois State Geological Survey and the U. S. Bureau of Mines, published Bulletin 151, presenting much valuable information of interest to those engaged in coal-mine operation.

As an aid in the preparation of coal for the consumer, an investigation carried on by Professors A. C. Callen and D. R. Mitchell in cooperation with the Zeigler Coal and Coke Company in typical Illinois mines was summarized in Bulletin 217. The publication has served as a guide to coal producers who are interested in results that may be obtained from proper preparation of coal, for even after coal has been brought out of the mine, it usually has to be subjected to some kind of preparation process to make it acceptable for the market.

Bulletin 285 by Professors C. M. Smith and D. R. Mitchell, relating to the potential recovery of coal and other products that find their way into the waste-pile accumulations from underground mine operations, shows that very substantial savings can be effected by recovering waste coal and by better utilization of the by-products with the methods and equipment now economically available.

Mine Ventilation.-The measurement of air quantities and energy losses in mine entries was made the subject of extensive investigations by Professors A. C. Callen and C. M. Smith in cooperation with the Illinois State Geological Survey, that resulted in the publication of four bulletins,-Nos. 158, 170, 184, and 199. Further studies in mine ventilation made by Professor Smith, relate to the use of shaft-bottom vanes as devices for deflecting the course of air used in ventilation. The results of these examinations are reported in Bulletin 249.

Additional studies by Professor Smith show that models may be safe guides in the solution of many ventilation problems. The use of these models is described in Bulletins 265 and 279. Surveys made by Professor Smith in typical Illinois mines, the findings of which are published in Bulletin 297, indicate that many

ventilating systems are deficient due to number of causes. The bulletin provides information for correcting some of the troubles and for securing safer and more economical working conditions in mines.

1. MECHANICAL-ENGINEERING INDUSTRIES

General.-Outstanding contributions that have added much to the prestige of the Engineering Experiment Station have been made in such branches of mechanical engineering as steam and automotive power; thermodynamics; heating, ventilating, and air conditioning; mechanical refrigeration; and shop production and management. Some of the projects carried on in these several lines are described briefly in the following pages.

1. PRIME MOVERS

Steam and Steam Power.---- Bulletin 58, entitled "A New Analysis of the Cylinder Performance of Reciprocating Engines", by Mr. J. P. Clayton, was designated by Professor Charles Russ Richards, Head of the Department of Mechanical Engineering and later Dean of the College, as "the most noteworthy contribution to the science of the steam engine ever made by an American, and as probably the most notable work since the appearance of Hirn's analysis." The sequel, "Steam Consumption of Locomotive Engines from the Indicator Diagrams," Bulletin 65, was prepared by Mr. Clayton after analysis of data taken in various locomotive testing plants in this country. By means of the method developed, it is possible to determine the steam consumption of locomotives in service from indicator diagrams with a highly satisfactory degree of accuracy.

Bulletin 278 presents a critical analysis of the data taken from a series of tests made by Professor A. P. Kratz, to determine the conditions prerequisite for the continuous operation of one of the 500-horsepower Babcock and Wilcox boilers then installed in the Mathews Avenue Power Plant at the University. The investigations involved a detailed study of the boiler and furnace losses under a variety of conditions of load, depth of fuel bed, and draft, under the usual working arrangement of the plant with Illinois coal as fuel. The analysis designates the losses chargeable to boiler, furnace, and setting. The publication presents, also, complete

forms for conducting and calculating a set of boiler tests.

Bulletin 168 entitled "Heat Transmission through Boiler Tubes," by Professor H. O. Croft, presents the results of a study of the factors affecting the transmission of heat through the tubes of water-tube boilers. The study provides information valuable for making allowances in boiler design for the normal losses in the efficiency of the heating surface under the usual operating conditions. Another set of combustion tests made under the direction of Professor Kratz on the boilers of the University Power Plant and summarized in Bulletin 213, was made in cooperation with the Zeigler Coal and Coke Company for the purpose of comparing the performance characteristics of several Illinois coals as determined by their influence on the over-all efficiency, temperature of the flue gases, combustion rate, and draft required, when the boiler unit was operated at given steaming capacities.

Gas and Automotive Power.-Investigations carried on in gas and automotive power by Professor A. P. Kratz and Mr. C. Z. Rosecrans and published in Bulletins 133 and 157 were devoted to a study of the basic principles underlying the explosions of gaseous fuels and the economic operation of the internal-combustion engine. The particular experiments related to a study of the factors producing detonation and a critical examination of the velocity of the explosive wave. Bulletin 133 contains a study of the physical phenomena involved in the explosion of various mixtures of illuminating gas and air. This includes the determination of the effect of differently shaped explosion vessels and of turbulence at the time of ignition, as well as a study of the heat loss from the burning mass of gas. Bulletin 157 summarizes a study of the flame propogation in a closed cylindrical bomb and compares the results of a theoretical analysis of flame propogation with the actual phenomena as observed by means of photographic records.

z. THERMODYNAMICS

Properties of Steam.-A very important contribution to the knowledge of steam was made by Professor G. A. Goodenough in Bulletin 75 entitled "Thermal Properties of Steam", where he succeeded analytically in harmonizing the existing physical data on the properties of saturated and superheated steam and in the developing of a new

set of thermodynamic equations by means of which all of the various properties of steam may be computed by the methods of thermodynamics. The results, more consistent than those provided by formulas that had been previously devised, were of great interest to those who were experts in the field of thermodynamics, and formed the basis for later publication of his steam tables, which were such valuable additions to the literature in that field,-being in general use in English-speaking countries for computations connected with the design and performance of steam-engineering equipment of all kinds.

Another publication, Bulletin 139, entitled "An Investigation of the Maximum Temperatures and Pressures Attainable in the Combustion of Gaseous and Liquid Fuels," issued under the direction of Professor Goodenough, presents a formulation by means of which the maximum temperature resulting from the combustion of a fuel under predetermined conditions may be calculated.

Bulletin 150 by Mr. C. Z. Rosecrans and Mr. G. T. Felbeck, is concerned with the application of a rational thermodynamic analysis of the constant-volume, or Otto, cycle to laboratory-test results obtained from an engine operating on such a cycle, and with a discussion of the factors which prevent the actual engine from attaining the ideal performance as defined by the thermodynamic analysis. The laboratory work involved sixty-five tests made with a Bogart gas engine operating at constant load and speed with various compression ratios, using illuminating gas and hydrogen as fuels. Heat losses were deduced from a study of indicator cards; and a study of the heat processes was made for several variations of the Otto cycle.

Bulletin 160, "A Thermodynamic Analysis of Internal Combustion Engine Cycles," by Professor G. A. Goodenough and Mr. J. B. Baker was somewhat of a sequel to the preceding two, and contains the report of an analytical investigation of the variations in efficiency with modifications in mixture, compression ratio, expansion ratio, and heat losses computed for Otto and Diesel-cycle engines, looking to the determination of a set of accurate values for the ideal efficiency of the two cycles in order that such values might replace the usual air standard.

Bulletin 262 by Mr. E. A. Hershey and Professor R. F. Paton summarizes the

results of test made to determine flame temperatures in the cylinder of an internal-combustion engine, measured by an optical method with the use of the spectroscope and optical pyrometer,-a method capable of following the rapid fluctuations which occur in the cylinder, but not in any way affecting the combustion process itself. The published results include not only the maximum temperatures during the combustion for varying fuel ratios, but also compare those recorded values with the computed values.

3. HEATING, VENTILATING, AND AIR-CONDITIONING

Heat Transmission of Building Materials.-The studies in heating, ventilating, and air-conditioning began with observations made to determine the relative ability of standard building materials used in the construction of exterior walls to resist the transmission of heat under service conditions. Bulletin 102 summarizes the results made under the direction of Professor A. C. Willard to obtain information relating to the principles of heat transmission by conduction, radiation, and convection of heat transmission to, through, and from a simple wall.

Warm-Air Furnaces and Heating Systems.-A series of investigations on warm-air furnaces and heating systems begun in October, 1918, under the general direction of Professor A. C. Willard in cooperation with the National Warm-Air Heating and Ventilating Association, which in 1928 became known as the National Warm-Air Heating Association, and in 1933 as the National Warm-Air Heating and Air-Conditioning Association, has continued to date. Bulletin 112, the first of the series stated the objectives of the investigations to be as follows:

1. To determine the efficiency and capacity of commercial warm-air furnaces under conditions similar to those existing in actual installations with leaders, stacks, and registers to form a complete system.

2. To determine satisfactory and simple methods for rating furnaces so that the proper size and type of furnace can be definitely selected for the service required.

3. To determine the methods of increasing the efficiency and capacity of furnace heating equipment and the advantages or desirability of certain types of design.

4. To determine the heat losses in furnace heating systems and the value of insulating materials as affecting the economy of the furnace or the leaders and stacks, and finally of the system as a whole.

5. To determine the proper sizes and proportions of leaders, stacks, and registers supplying air to first, second, and third floors.

6. To determine the friction losses in the cold air or recirculating ducts and registers, their proper sizes and proportions, and the arrangment of location.

7. Eventually, to make a study and comparison of outside and inside air circulation as affecting the economy and operation of furnace systems.

The tests were conducted with a number of types of warm-air furnaces installed on the main floor of the Mechanical Engineering Laboratory. The piping was supported by an open steel structure that simulated the conditions of a three-story residence. Other bulletins reporting the descriptions and findings of the tests are: 117, 120, 141, and 188. The conclusions stated in Bulletin 117 are reported in full as follows:

1. The use of thin sheets of asbestos paper on bright tin heat pipes results in a waste of heat. The use should be abandoned.

2. Uncovered bright tin pipes are more efficient carriers of heated air than asbestos paper-covered bright tin pipes.

3. This fact is true regardless of the degree of brightness of the tin surface.

4. No small number of applications of asbestos paper will suffice as an insulator. Several thicknesses are necessary to make a covering equal in this respect to bare tin.

5. The accumulation of dust and dirt on the pipes does not greatly alter the amount of the loss.

6. The heat loss from warm-air furnace pipes covered with one layer of asbestos paper is a serious item in the cost of heating, amounting to more than 5 per cent of the coal consumption, depending upon the number and size of the pipes used.

7. The fact that pipes are partly protected from convection currents of air by joists and studding does not greatly affect the loss.

8. Unless the insulation excels the uncovered bright tin in heat-insulation properties, it should not be used.

9. Such materials are available and the tests have shown their merits.

The results of these investigations were summarized by Dean Milo S. Ketchum in a paper entitled "Value to the Industries of Engineering Research at the University"[1] as follows:

1. The determination of the performance characteristics of furnaces of various types, that is, the relation between combustion rate, draft, efficiency, heating capacity, and air temperatures throughout the system.

1. Proceedings of the Association of Land-Grant Colleges, Nov. 17-19, 1925, pages 259-260.

2. The determination of the heat-carrying capacity of first, second, and third floor leaders and stacks. This makes it possible to design a warm-air system in accordance with heat loss from a building, thus placing the warm-air plant on the same basis as a steam or hot-water plant.

3. The positive demonstration, in the research residence equipped with a modern furnace heating plant, that a properly designed warm-air system is a successful and satisfactory method of heating the better as well as the smaller class of American homes.

4. The determination of the proper type of covering for basement pipes in order to reduce the heat loss from such pipes.

5. The determination of the principal sources of heat loss from a furance and the recommendation of means by which such losses may be minimized.

6. The determination of the relative effectiveness of several types of water pans when used as humidifiers.

7. The investigation has also made possible the formulation of a standard code for installation which has been accepted by the American Society of Heating and Ventilating Engineers and other national organizations. The adoption of the code is of the greatest value to the home owner, the manufacturer, and the installer.

Bulletin 300, "Pressure Losses Resulting from Changes in Cross-sectional Area in Air Ducts", by Professors A. P. Kratz and J. R. Fellows, presents an account of an investigation of the losses occurring in abrupt expansions and contractions in air ducts, and in various types of transition sections connecting ducts of different diameters.

Several experiments were run on the Warm-Air Research Residence after it was completed in 1923, to examine the efficiency of different makes of warm-air furnaces in domestic heating. In order to secure comparative results, tests were made simultaneously in the Mechanical Engineering Laboratory and the residence. These experiments are reported in Bulletins 189, 246, and 266.

The greatest interest in the performance of any heating plant centers on the records secured during the period of worst weather and load conditions. Circular 15 by V. S. Day, outlines the results obtained by the warm-air heating plant in the Research Residence during the 48-hour test when the average outdoor temperature was about three degrees below zero F. The circular also contains a brief description of the building and the heating plant.

Further investigations carried on in the Research Residence with oil-fired, forced-air furnace systems conducted through the heating seasons of 1934, 1935

and 1936, are summarized in Bulletin 318. The experiments were concerned with comparisons of the heating efficiency of a system employing a conversion oil-burning furnace with one using a warm-air furnace designed especially for warm-air combustion.

Direct Steam and Hot-Water Heating Systems.-In 1926, a cooperative agreement was signed with the National Boiler and Radiator Manufacturers' Association which later became known as the Institute of Boiler and Radiator Manufacturers, and the Illinois Master Plumbers' Association, to undertake studies in steam and hot-water heating systems. Bulletins 169, 192, and 223 were published, summarizing the findings of these investigations. The first was concerned with the effect that various types of commercial radiator enclosures, shells, and covers have on the steam-condensing capacity of direct cast-iron radiators. The second was a continuation of the first under the special conditions of a zero-weather situation. The third dealt with studies involving variations in a number of factors attending the heating of typical rooms supplied with cast-iron radiators.

Sufficient data have been developed from tests made on modern commercial radiators operating under actual service conditions to indicate that the heating performance of a radiator varies greatly with the type of radiator and that the best heating effects are often obtained with radiators which condense the least amount of steam. In addition, research indicates, contrary to previous opinions, that enclosures and shields may improve the performance of such radiators and reduce the steam condensation, provided the enclosure and shields are properly designed for the purpose.

Bulletin 349 by Professors A. P. Kratz and M. K. Fahnestock and others, relates to studies carried on in cooperation with the Institute of Boiler and Radiator Manufacturers concerning the performance of different types of steam and hot-water heating systems and the resulting comfort conditions in the I-B-R Research Home in Urbana. The publication, the first report of the investigations scheduled to be conducted in this new building, includes a description of the apparatus used and provides results so far obtained by the experiments.

Summer Cooling of Residences.-During the summers of 1932 to 1938 inclusive, investigations were made under a cooperative agreement with the National Warm-Air Heating and Air-Conditioning Association, the American Society of Heating and Ventilating Engineers, and others, on methods of cooling the Warm-Air Research Residence, recently constructed for experimental purposes. The tests, reported in Bulletins 290, 305, and 321, were made on systems involving the use of ice-cooled water together with out-door air for cooling purposes in comparison with mechanical cooling systems.

Flow of Air through Orifices in Circular Plates.-The flow of air through circular orifices in thin plates was the subject of an investigation directed by Professor J. A. Polson that resulted in the publication of two bulletins, Nos. 207 and 240. The first was concerned with circular orifices having a rounded edge of approach and the second with circular orifices having a square edge of approach. The investigation supplied data which shows that the rounded edge is preferable to the square in that errors due to the derangement of the edge, are less likely to occur, and in addition, provided coefficients which may be applied to Fliegner's formula for the flow of air.

Hand-Firing of Bituminous Coal.-Circular 46 entitled "Hand-Firing of Bituminous Coal in the Home," by Professors A. P. Kratz and J. R. Fellows and Mr. J. C. Miles, presents in non-technical language the principles involved in the combustion of bituminous coal and describes methods of operating a hand-fired furnace to produce the least smoke and greatest economy and efficiency, with the various grades of coal found in a war-time market.

Ventilation Research on the Holland Vehicular Tunnel.-A series of six comprehensive reports representing experimental work carried on at the University over a five-year period was made to the Chief Engineer of the New York State and New Jersey Interstate Bridge and Tunnel Commission during 1920-1925 by Professor A. C. Willard, under whose direction the work was conducted, to supply data needed in the design and construction of the new vehicular tunnel being constructed under the Hudson River between New York City and Jersey City. The tests furnished sufficient information to determine the size of the ducts that would be required to handle

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3 600 000 cubic feet of air per minute in order to dilute the exhaust gases from 4 000 automobiles per hour. They provided data, also, to determine the sizes and power requirements of the eighty-four supply and exhaust fans and motors that would be needed to move the air input and outgo. Since this was the first long subaqueous tunnel to be constructed for automobile traffic which approached the density of city-street conditions, the designers were obliged to depend almost entirely upon the results of these investigations for basic information necessary to formulate their plans.

4. MECHANICAL REFRIGERATION

Ammonia Vapor.-An important analytical investigation under the immediate attention and direction of Professor G. A. Goodenough entitled "The Properties of Saturated and Superheated Ammonia Vapor," published in Bulletin 66 has been of utmost value in the field of mechanical refrigeration. In the course of this experiment, there was assembled for the first time all of the existing data relating to the properties of ammonia vapor. "After a careful analysis of these properties and of the application of their dynamic principles, it became possible to devise formulae for the calculation of the several essential properties of the saturated and superheated vapor of ammonia, from which were calculated tables which are now very largely used by engineers who have occasion to deal with problems in mechanical refrigeration."[1] These formulae have enabled refrigerating engineers to make calculations concerning mechanical refrigeration with far greater accuracy than had theretofore been possible.

Ammonia Condensers.-Although tests of condensers had been reported at various times, the results were isolated and fragmentary. Accordingly, it seemed desirable to undertake a systematic and rather extensive program of research in this field in order to correlate and give proper weight to the various factors entering into the design and operation of a number of outstanding types of ammonia condensers. In support of this view, a study was begun in 1926 by Professors A. P. Kratz and H. J. Macintire and Mr. R. E. Gould, which resulted in the publication of three bulletins, Nos. 171, 186, and 209. Bulletin 171 presents a summary of a study made to

1. The Technograph, May, 1918, page 170.

determine the coefficient of heat transfer for the various types of ammonia condensers, regarding the total surface exposed to saturated ammonia vapor as a whole. Bulletin 186 presents the results of a study made to ascertain the effect of reducing the condensing surface of the shell-and-tube type of condenser, by decreasing the length of the condenser tubes and by reducing the number of effective tubes, and to determine the coefficient of heat transfer for the double-pipe type of superheat remover. Bulletin 209 presents the results of observations on the performance of a horizontal shell-and-tube condenser over a wide range of operating conditions and with certain variations in the arrangement of the surface.

Flow of Brine in Pipes.-"The Flow of Brine in Pipes", a matter of interest to everyone connected with the refrigeration industry, was the subject of an investigation by Mr. R. E. Gould and Mr. M. L. Levy reported in Bulletin 182. The experiment was particularly directed towards ascertaining the relation between the friction factor and Reynold's number when commercial calcium-chloride brine is circulated in standard wrought-iron pipes under the conditions encountered in refrigeration practice, and also towards determining the viscosity of commercial brine. Closely related to this investigation was one carried on by Professors A. P. Kratz and H. J. Macintire and Mr. R. E. Gould on the topic "Flow of Liquids in Pipes of Circular and Annular Cross-Sections", reported in Bulletin 222. This study was undertaken to ascertain the relation between the friction factor and Reynold's number for two sizes of standard wrought-iron pipes and for channels of annular cross-section, with two fluids, water and commercial calcium-chloride brine, and to determine the head loss resulting from the use of standard cast-iron elbows in pipe lines conveying commercial brine.

5. SHOP PRODUCTION AND MANAGEMENT

Molding Sand.-Two investigations have been carried on under the direction of Professor C. H. Casberg on a study of the properties of molding sand. The first summarized in Bulletin 200 deals with the laboratory tests of molding sand from all producing pits and from forty-two undeveloped deposits through the State and has enabled many foundry men to substitute excellent sand from local pits for

inferior grades imported at considerable expense from other areas and even from other states.

The second set of investigations, undertaken with the assistance of Professor C. E. Schubert, was reviewed in Bulletin 281. The report outlines a short but accurate method for determining the durability of a given sample of molding sand, and presents a formula developed from laboratory tests, for computing bond strength, or the amount of clay or sand necessary to restore used sand to its original strength. The results of these studies have enabled foundrymen to select clays and sands that are especially adapted to their particular needs.

Core Oils.-A study of core oils by Professors C. H. Casberg and C. E. Schubert was reported in Bulletins 221 and 235. The first was related to a determination of the relation between the tensile-strength characteristics of cores and the physical and chemical properties of a number of commercial core oils used as a binder, and of the effect of moisture on the tensile strength of baked cores. The second was concerned with the suitability of soy-bean oil either as a substitute for, or a dilutent of, other oils used for the purpose of making cores.

Twist Drills.-Data obtained under the direction of Professor B. W. Benedict on the performance of twist drills operating in gray or soft cast iron, and summarized in Bulletin 103 entitled "An Investigation of Twist Drills", serve the useful purpose of determining the relation between the helix angle of twist drills and the several methods of point-grinding, and torque, thrust, and endurance ability of such drills. Data summarized in another bulletin, No. 159, of the same title provide information of the same nature for both gray cast iron and steel. Both sets of experiments serve to substitute scientific methods for rule-of-thumb practice; and the figures indicate a substantial economy in operation for helix angles between 32 and 35 degrees. A special drilling-machine dynamometer, constructed for these tests, provided all essential records of power input and consumption, friction losses, torque, and thrust in drilling. One-inch, high-speed drills of many well-known makes were used in the experiments.

Spur Gears.-"An investigation of the Efficiency and Durability of Spur Gears" is the title of Bulletin 149 written by Professor C. W. Ham and others that came out of a series of studies that were begun in October, 1922, to study the effect of varying loads and speeds on the efficiency and durability of the several standard forms of gear teeth in common use. The gears were made of various materials and were tested under a variety of conditions of lubrication. The results provide reliable data with which to correlate the wearing properties of gear teeth to their size, shape, and composition, under different conditions of load, speed, and lubrication.

Bulletin 335, entitled "A Photoelastic Study of Stresses in Gear-Tooth Fillets", by Professor T. J. Dolan and Mr. E. L. Broghamer, presents the results of a study of some of the factors influencing the localized stresses occurring at the fillets of several types of gear teeth, as obtained from a series of tests of bakelite models of spur-gear teeth, utilizing the photoelastic method of stress analysis.

m. METALLURGICAL INDUSTRIES

General.-Several studies have been made physically and chemically to examine the structure and behavior of metals and alloys as they are used in engineering practice. The most important of these relate to electric welding, hardenability of steel, transverse fissures in steel rails, and fatigue of metals, and are discussed briefly in the following statements.

Electric Welding of Structural Steel.-A set of investigations in electric welding of structural steel was begun in 1931 in cooperation with the Chicago Bridge and Iron Works. Other organizations that later joined in investigation, include The Public Roads Administration, Federal Works Agency; The Association of American Railroads; and the Bureau of Ships, Navy Department, U. S. Government; American Welding Society; and the American Institute of Electrical Engineers. The studies, conducted by Professors W. M. Wilson, A. B. Wilder, W. H. Bruckner, and others, and extending over a period of approximately fourteen years, have resulted in the publication of Bulletins 310, 327, 337, 344, and 350, and Circular 21. These tests involving studies of arc and spot welding of lap and butt welds under both commercial and ideal conditions on fatigue strength of welded connections of structural

members serve to supply important information regarding the behavior of welded steel and the limits of unit stresses permissable to use in the design of structural parts.

Heat-Treatment of Steel.-A study of the heat-treatment of steel is presented in Reprint 31 by Professor H. L. Walker. The discussion deals especially with the principles involved in the treating process and with the behavior of the metal during the operation.

The Hardenability of Steels.-In order to supply information regarding the hardenability of steel,-a term that refers to the depth of surface hardening, Professor W. H. Bruckner carried through a series of tests, the results of which were summarized in Bulletin 320. The information obtained was especially valuable to those interested in the use of carburized and hardened roller bearings.

Microscopic Structure of Steel.-Many investigations on the microscopic structure of steel have been made as a part of the studies of fatigue of metals, transverse fissures in steel rails, continuous welded rails, welded structural steel, and other experiments, supplementing the mechanical and chemical tests conducted to examine the properties of engineering materials.

n. ACOUSTICS OF BUILDINGS AND BUILDING MATERIALS

Acoustics of Auditoriums.-An interesting set of investigations made in the attempt to correct the acoustical defects of the University of Illinois Auditorium resulted in the publication of Bulletin 73, entitled "Acoustics of Auditorims", by Professor F. R. Watson, and of Bulletin 87, entitled "Correction of Echoes and Reverborations in the Auditorium, University of Illinois", by Professors F. R. Watson and J. M. White. By rather inexpensive methods in the use of drapes, felts, and other similar materials, following a long, systematic, and painstaking investigation, the acoustical properties of the building were materially improved. The publication is especially interesting to architects and others employed in the design of large-audience rooms where the elimination of echoes and reverborations is a vital necessity for satisfactory service.

Acoustics of Building Materials.-The construction of such structures as office buildings, hotels, hospitals, and apartment houses with sound-proof walls and par-

titions has become so especially important because of the disconcerting noises resulting from the advent of modern forms of street and air transportation, the increased number of manufacturing plants and mechanical devices, and the extensive use of radio receiving sets, that it has claimed the attention of architects and others interested in the design of public buildings. To provide information that would solve some of these problems, Professor F. R. Watson carried on a series of tests with a number of building materials, the results of which were summarized in Bulletin 127, entitled "Sound-Proof Partitions". These experiments proved to be effective in supplying data useful to individuals and firms engaged in the design, construction, and furnishing of buildings and building materials.

o. HIGHWAY ENGINEERING

General.- Research in highway engineering has extended to proper methods of grading and oiling earth roads, to designs of concrete road slabs and slab joints and fillers, and to the design, construction, and maintenance of gravel roads. Circular 11, entitled "The Oiling of Earth Roads", by Professor W. M. Wilson, presents information concerning the causes of failure of oiled roads and recommendations for the satisfactory construction of such roads in practice. Circular 18, prepared by Professor C. C. Wiley on "The Construction, Rehabilitation, and Maintenance of Gravel Roads Suitable for Moderate Traffic", relates to problems involved in the development of secondary lines of highway travel.

p. RAILWAY TRACK AND ROLLING STOCK

General.-The University of Illinois has contributed more than any other educational institution in this country to the sum-total of knowledge concerning the behavior of railway track and the performance of rolling equipment under traffic conditions. Investigations in the railway-engineering field extending over a period of thirty years include such projects as stresses in railroad track, transverse fissures in steel rails, continuous welded rails, locomotive operation, train resistance, and car-wheel and brake-shoe performance. Brief descriptions of work in these subjects appear in the following pages.

Stresses in Railroad Track.-Continuously from late in 1913 until the spring of 1941,

over a quarter of a century,-the investigations of stresses in railway track were carried on under the general direction of a joint committee of twenty-two men, including engineers and officials holding important and responsible positions among the railroads of the country, representing the American Railway Engineering Association and the American Society of Civil Engineers, and with contributions from a number of the leading railroads and steel companies of the country. It was the general purpose of the committee to determine experimentally the stresses that were developed in the rails, ties, ballast, and roadbed under ordinary conditions of service in standard American railroad track. As chairman of the committee, Professor A. N. Talbot served in large measure to determine the course of the investigations and to direct the work of the experiments and the preparation of the seven progress reports that were published in the Proceedings of the American Railway Engineering Association and the American Society of Civil Engineers.

All of these reports were ably illustrated by means of extensive charts and diagrams. The first one opens with a comprehensive analytical treatment of the action of railway track as an elastic structure, and then follows with an elaborate description of the apparatus used in the tests and the methods of conducting the experiments and with a presentation of the results obtained. This publication presents really the first definite and comprehensive information on the behavior of railway track as a structure. The second report deals with the effect of speed and counterbalance on stresses in the rails; depression and flexure of the track, and the distribution of the pressure of the ties; and transmission of pressure through the ballast.

Studies made on four cooperating railways with several types of steam locomotives on both straight and curved track, are summarized in the third report. Some idea of the amount of detail involved in the field and office work of this report is gained from the statement of Professor Talbot that about 470 000 strain-gage records were made and used in the course of procedure. The action of several different types of electric locomotives on straight and curved track was one of the principal topics of the fourth report. The results of these studies give information

that is very important in judging the effects upon track of differences in design of the various types of electric motive power. Another major topic treated in the fourth report was the effects of canting of rail.

The fifth report gave consideration to the rail joint and its relation to rail, ties, and ballast. The discussion embodies a lengthy mathematical presentation of the action of joints and joint bars under load. The sixth report continues with the results of laboratory and field tests of rail joints, tests of GEO track, and general properties and qualities of track as related to stiffness of the rail support and to the uniformity of the play between the rail and tie and between the tie and its support upon the application of load. The seventh and last report deals with tests of rails and rail joints made with locomotives operating at various speeds and with rail and joint-bar stresses and depressions measured by means of a magnetic strain gage and recorded on oscillograph film.

These investigations, masterpieces in their field, and the first to approach the subject in a truly scientific manner, have served to develop a rational body of knowledge of vital importance to railway service; for the information obtained thereby and the fundamental principles established as a result of these studies on the action of the track structure in all its parts, have had a great influence on the further development of railway operation. They have led to improvements in practice in the design and maintenance of track structure to carry modern rolling stock under high-speed conditions. They have served, too, to indicate the balanced relationships that should exist between the elements of track structures and between track and motive power, thereby resulting in modifications in design of track and steam and electric locomotives and providing for greater safety and efficiency in train operation. These experiments have been outstandingly instrumental in calling the attention of engineering and industrial interests to the character of research done at the University of Illinois and have been correspondingly influential in extending the reputation of the University throughout the scientific world.

Transverse Fissures in Steel Rails.-In 1931, an investigation was undertaken under

the direct supervision of Professor H. F. Moore, in cooperation with the Rail Manufacturers' Technical Committee and the American Railroad Association, now the Association of American Railroads, acting through its subsidiary, the American Railway Engineering Association, and a number of steel companies, on the subject of transverse fissures in steel rails, that is still in progress. Ten progress reports have been made so far to the American Railway Engineering Association, and these have been republished by the Station as Reprints 4, 8, 11, 12, 14, 16, 21 22, 24, and 28.

These reports, providing materials from both laboratory and field tests, relate to such topics as previous investigations of fissures in steel rails, chemical and metallographical structure of steel rails, mechanism of the formation and development of internal fissures in rails, origin and prevention of shatter cracks in rails, effect of heat-treatment on the mechanical properties of rails, and end-hardening and batter of rails.

The results of these systematic investigations carried out in the laboratory under controlled conditions and in the field on a number of trunk lines offering a variety of conditions of track and rolling stock, have served to supply an extensive body of dependable knowledge regarding the formation and cycle of these fractures or fissures and to provide remedial methods for alleviating the attending difficulties.

Continuous Welded Rails.-To obtain first-hand information on the subject of continuous welded rails in steam railway operation, a form of track structure essentially new in steam-road service, a series of investigations was begun in 1937 under the direction of Professor H. F. Moore, in cooperation with the American Association of Railroads and its subsidiary, the American Railway Engineering Association. Two reports dealing with the behavior of continuous stretches of such construction in open-track formation, have been made to the American Railway Engineering Association, that have been of immense interest and value to those engaged in the construction and maintenance of railway track. These were published by the Station as

Reprints 13 and 17.

The first of these contains a description of the types of welded joints studied, which include gas-welded by oxy-acetylene torch without pressure, Thermit process with pressure, electric flash butt welds with pressure, and gas-heated butt welds with pressure. The report continues with a description of etch tests, and with metallographic and hardness surveys; with mechanical tests of specimens of welded rails; with tests of welded joints under repeated wheel load; and with bend and drop tests of welded joints.

The second report deals with further studies of welding including tests on the behavior of welded joints under repeated wheel load. It also covers metallographic tests and mechanical tests of specimens from welded joints.

Shelly Spots in Steel Rails.-Studies that have been carried on in the Talbot Laboratory since 1942 by Professor R. E. Cramer under the general direction of Professor Moore, in cooperation with the American Railway Engineering Association and the Rail Manufacturers' Technical Committee, relate to causes and remedies for shelly spots in steel rails,-those structural defects that are due to internal cracks occurring on the gage side of the rail resulting in the breaking out of the head a wedge-shaped piece of metal and in the ultimate failure of the rail section. The reports of these investigations published in the Proceedings of the American Railway Engineering Association, are republished in Reprints 25 and 29.

Fatigue Failure of Rail Joint Bars.-Another investigation, made in cooperation with the American Railway Engineering Association, begun under the direction of Professor Talbot and carried forward to date by Professor Norville J. Alleman under the general supervision of Professor H. F. Moore, is described at some length in Reprints 26 and 30. The experiments relate specifically to fatigue failures in rail

joint bars under repreated heavy loadings simulating those found under traffic conditions.

Locomotive Operation.- A number of locomotive tests, carried on in the locomotive laboratory at the University under the direction of Professor E. C. Schmidt in cooperation with several trunk-line railway companies, have been of intense interest and value to those engaged in the design, manufacture, and operation of steam locomotives. The first of these was on a Consolidation type of engine loaned by the Illinois Central Railroad Company in 1913. The particular purpose of the tests was to break in the testing plant, which had just been installed, and to compare the performance of this engine as it came from service with the results obtained after the cylinders, pistons, and other working parts had been repaired and placed in first-class condition. The results of the investigations were published in Bulletin 82. The publication contains, also, an excellent detailed description of the locomotive testing plant itself.

In 1916 there began another set of tests,-this time with a Mikado type of Locomotive loaned by the Baltimore and Ohio Railroad Company to determine the steam-producing values of different sizes of coal when burned in a locomotive firebox. These results were published in Bulletin 101. Still another series of tests was run on a Mikado type of locomotive,-this one loaned by the Illinois Central in 1930, to make comparisons on the performance of a locomotive with and without a syphon. The results of the series were published in Bulletin 220.

Locomotive Front-Ends.-The results of studies made by Professor E. G. Young to provide information regarding the production of draft in a locomotive and the movements of air and gases through a locomotive front-end proved to be of much economical value to those engaged in the manufacture and operation of steam locomotives. The work, summarized in Bulletins 256 and 274, included tests of a quarter-scale model of a U. S. Railway Administration heavy 2-8-2 locomotive front-end in which about 300 front-end arrangements were used and a number of stacks and nozzles were employed with steam jets in making the investigations. Bulletin 256 contains also an excellent digest of the results of a number of other experiments carried on in

this and other countries to examine the front-end performance of steam locomotives.

Railway Train Resistance.-In 1908, a series of tests was begun under the direction of Professor E. C. Schmidt on the Chicago Division of the Illinois Central Railroad that would provide data which would serve as a basis for computing tonnage ratings of various types of locomotives in railway service on that division. Tests were carried on by means of the dynamometer car owned jointly by the University and the railroad to determine specifically the resistance of freight cars moving under the usual conditions of loads, speeds, and track and equipment maintenance. The results of these investigations published in Bulletin 43, were long used as standards in American railway practice. Because of the demand, the bulletin was reprinted in condensed form in 1934.

Train-resistance tests were continued on the Illinois Central with this dynamometer car under varying weather conditions until 1912, when another bulletin No. 59, describing the effects of cold weather upon train resistance and tonnage ratings, appeared that provided additional information useful to men engaged in directing railway operation under cold-weather conditions.

Another publication, Bulletin 110, on the subject of passenger-train resistance, summarized the results of tests made on the Illinois Central by means of the same dynamometer car that was used in the previous investigations. The experiments covered a wide range of conditions of speed and rolling equipment.

All of these investigations enabled the railways to compute their tonnage ratings by scientific processes instead of by the rule-of-thumb practice that formerly prevailed, permitting a better balance between motive power and train loads for various grades and speeds, and thereby providing a substantial economy in train operation.

Railway Car-Wheel and Brake-Shoe Performance.-The performance of railway car wheels has been a subject of investigations at the University for about a quarter of a century. The first bulletins published by the Station in this field were Nos. 129, 134, and 135, issued in 1922-23, summarizing tests carried on under the supervision of Professor J. M. Snodgrass in cooperation with The Association of Manu-

facturers of Chilled Iron Car Wheels. These tests related to determinations of the magnitude and distribution of strains developed due to the fit of the wheel on the axle and to static loadings, of stresses produced in the wheel flanges due to horizontal thrusts, and of stresses caused in wheels by brake applications, and to determinations of brake-shoe friction and brake-shoe wear.

Continuing interest in the performance of railway brake shoes led to another series of tests under the direction of Professor Schmidt, and the publication of Bulletin 257, to study the coefficients of friction of brake shoes over the usual range of shoe pressures and wheel speeds for both chilled-iron and steel wheels.

In an attempt to determine the conditions that prevail during relatively long periods of brake application, such as those corresponding to service conditions on long descending grades, the work was continued,-this time in cooperation with The Association of Manufacturers of Chilled Car Wheels,-on chilled car wheels, and the results were published in Bulletin 298. The investigations included studies of resistance to heat-checking and cracking of the wheels, of strains developed in the wheels during these longer periods of braking control, and of the action of the brake shoes under such sustained application.

To supply the needs for new data on brake-shoe performance under conditions prevailing in high-speed streamlined train service, additional tests were carried on by Professor H. J. Schrader on steel wheels with speeds ranging from 60 to 140 miles an hour. The results of these investigations were published in Bulletin 301.

Another set of static tests made under the supervision of Professor F. E. Richart in cooperation with The Association of Manufacturers of Chilled Car Wheels was completed in 1937 and published in Bulletin 294. The tests gave consideration to stresses in chilled car wheels due to mounting the wheel on the axle, to static axle loadings, and to flange thrusts and to investigations of the breaking strength of wheel-tread rims.

A somewhat similar set of tests was conducted by Mr. Thomas J. Dolan and Mr. Rex L. Brown in cooperation with The Carnegie-Illinois Steel Corporation, but

with steel wheels as test specimens. The results of these studies were published in Bulletin 312

These studies and observations on the performance of car wheels and brake shoes have contributed a great stock of information so vitally important to designers, manufacturers, and operators of railway rolling stock that it has led to improvements in car wheel and brake-shoe design and construction, that have, in turn, promoted greater safety in train operation.

d. SUMMARY

General Statement.-While it is not possible to appraise or evaluate accurately the work of the Engineering Experiment Station, there is no doubt but that the long list of publications in the form of bulletins, circulars, and reprints listed at the end of this chapter is evidence that the Station in the more than forty years of its existence, has done much to provide accurate data regarding the properties of the materials used in engineering production, thereby aiding in the advancement of the sum-total of engineering knowledge and of the development of the industries of the State and Nation. Probably no other state agency in the world has been any more effective in extending the field of engineering science than the Engineering Experiment Station here at the University of Illinois.

The experiments undertaken include a wide range of subjects having particular interest to individuals and organizations engaged in industrial and professional practice; but while some advantages accrue directly and immediately to such individuals and groups, the ultimate benefits extend to the community, then to the State and the Nation. Such economic advantages include the proper utilization and conservation of natural resources as well as the recovery of waste products and the use of by-products, the production of a store of substitute materials and the improvements in performance of those already at hand, and the availability of entirely new products and processes.

While the Station has never had such financial support from federal funds as that allotted to the agricultural experiment stations connected with some of the larger land-grant colleges, its work has gone forward with steady but substan-

tial progress under the allowances and contributions provided from State and proprietary sources; and there can be little question but that the reputation the Station enjoys in the estimation of both the engineering profession and the general public as to the authoritative quality of the results attained and the unprejudiced character of the publications, has gone far in establishing the prestige which the University maintains among the educational institutions of the United States and the world at large.

PUBLICATIONS

OF THE

ENGINEERING EXPERIMENT STATION

OF THE

UNIVERSITY OF ILLINOIS

URBANA, ILLINOIS, U.S.A.

CASH WITH ORDERS FOR PUBLICATIONS
NO LONGER FREE

UNIVERSITY OF ILLINOIS BULLETIN

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UNIVERSITY OF ILLINOIS
ENGINEERING EXPERIMENT STATION
URBANA, ILLINOIS, U. S. A.

The Engineering Experiment Station was established by act of the Board of Trustees, December 8, 1903. It is the purpose of the Station to carry on investigations along various lines of engineering and to study problems of importance to professional engineers and to manufacturing, railway, mining, constructional, and industrial interests of the State.

The results of these investigations are published in the form of bulletins which record mostly the experiments of the Station's own staff of investigators. There are also issued from time to time, in the form of circulars, compilations giving the results of the experiments of engineers, industrial works, technical institutions, and governmental testing departments, and reprints of articles appearing in the technical press written by members of the staff and others.

Each bulletin issued by the Engineering Experiment Station is subject to a free initial distribution on the basis of existing mailing lists. It is also placed on sale with authorized agencies both in this country and abroad. A limited number of copies are available for free distribution upon request, for a period of six months after the initial distribution. After that time or as the supply of each bulletin approaches exhaustion, it is placed upon a reserve list. The effect of this action is to withdraw such bulletins from free distribution. Bulletins withdrawn from free distribution are available to any applicant upon payment of the assigned price, so long as the supply lasts. Remittance should accompany the order.

Most bulletins no longer procurable from the Station can be borrowed from general and technical libraries, nearly five hundred of which are on the Station's mailing lists.

A name is placed upon the regular mailing lists of the Station at the personal request of the person, institution, or company so desiring.

500—5-47—35140

PUBLICATIONS OF THE ENGINEERING EXPERIMENT STATION

Bulletins, circulars, and reprints have been grouped here for the reader's convenience under the various Departments of the College of Engineering: Architectural Engineering; Ceramic Engineering; Chemical Engineering; Civil Engineering; Electrical Engineering; Engineering Physics; Mechanical Engineering; Mining and Metallurgical Engineering; Railway Engineering; and Theoretical and Applied Mechanics. Each publication is classified according to the department of the senior author. Many publications report cooperative investigations involving more than one department.

Page numbers of departmental groups of publications are:

The **departmental lists** are supplemented by two others. A **numerical list** (page 23) will aid those readers who know the serial number of a publication they seek, but not its author or his department. An **alphabetical index of authors** (page 26) gives the serial numbers of each author's publications and the departments of engineering under which the complete title of the publication is listed.

DEPARTMENTAL LISTS

ARCHITECTURAL ENGINEERING

BULLETINS

13. An Extension of the Dewey Decimal System of Classification Applied to Architecture and Building, by N. C. Ricker. 1906. *None available.*

16. A Study of Roof Trusses, by N. C. Ricker. 1907. *None available.*

35. A Study of Base and Bearing Plates for Columns and Beams, by N. C. Ricker. 1909. *None available.*

121. The Volute in Architecture and Architectural Decoration, by R. Newcomb. 1921. *Forty-five cents.*

CERAMIC ENGINEERING

BULLETINS

118. Dissolved Gases in Glass, by E. W. Washburn, F. F. Footitt, and E. N. Bunting. 1920. *Twenty cents.*

140. The Viscosities and Surface Tensions of the Soda-Lime-Silica Glasses at High Temperatures, by E. W. Washburn, G. R. Shelton, and E. E. Libman. 1924. *Forty-five cents.*

154. An Investigation of the Translucency of Porcelains, by C. W. Parmelee and P. W. Ketchum. 1926. *Fifteen cents.*

163. A Study of Hard Finish Gypsum Plasters, by T. N. McVay. 1927. *Thirty cents.*

179. An Investigation of Checkerbrick for Carbureters of Watergas Machines, by C. W. Parmelee, A. E. R. Westman, and W. H. Pfeiffer. 1928. *Fifty cents.*

181. The Thermal Expansion of Fireclay Bricks, by A. E. R. Westman. 1928. *None available.*

CERAMIC ENGINEERING, Continued

193. An X-Ray Study of Firebrick, by A. E. R. Westman. 1929. *Fifteen cents.*
201. Acid Resisting Sheet Iron Cover Enamels, by A. I. Andrews. 1929. *Twenty-five cents.*
214. The Effect of Furnace Gases on the Quality of Enamels for Sheet Steel, by A. I. Andrews and E. A. Hertzell. 1930. *Twenty cents.*
224. The Effect of Smelter Atmosphere on the Quality of Enamels for Sheet Steel, by A. I. Andrews and E. A. Hertzell. 1931. *Ten cents.*
225. The Microstructure of Some Porcelain Glazes, by C. L. Thompson. 1931. *Fifteen cents.*
227. The Effect of Smelter Atmospheres on the Quality of Dry Process Enamels for Cast Iron, by A. I. Andrews and H. W. Alexander. 1931. *Ten cents.*
229. The Effect of Thermal Shock on Clay Bodies, by W. R. Morgan. 1931. *Twenty cents.*
233. An Investigation of the Properties of Feldspars, by C. W. Parmelee and T. N. McVay. 1931. *Thirty cents.*
248. A Study of a Group of Typical Spinels, by C. W. Parmelee, A. E. Badger, and G. A. Ballam. 1932. *Thirty cents.*
271. Determination of Mean Specific Heats at High Temperatures of Some Commercial Glasses, by C. W. Parmelee and A. E. Badger. 1934. *Thirty cents.*
273. Mechanical-Electrical Stress Studies of Porcelain Insulator Bodies, by C. W. Parmelee and J. O. Kraehenbuehl. 1935. *Seventy-five cents.*
284. Oxidation and Loss of Weight of Clay Bodies during Firing, by W. R. Morgan. 1936. *Fifty cents.*
311. The Surface Tensions of Molten Glass, by C. W. Parmelee, K. C. Lyon, and C. G. Harman. 1939. *Free upon request.*

CIRCULARS

14. The Measurement of the Permeability of Ceramic Bodies, by P. W. Ketchum, A. E. R. Westman, and R. K. Hursh. 1926. *Fifteen cents.*
17. A Laboratory Furnace for Testing Resistance of Firebrick to Slag Erosion, by R. K. Hursh and C. E. Grigsby. 1928. *Fifteen cents.*
22. Condensation of Moisture in Flues, by W. R. Morgan. 1934. *Thirty cents.*

CHEMICAL ENGINEERING

BULLETINS

17. The Weathering of Coal, by S. W. Parr, N. D. Hamilton, and W. F. Wheeler. 1907. *None available.*
24. The Modification of Illinois Coal by Low Temperature Distillation, by S. W. Parr and C. K. Francis. 1908. *Thirty cents.*
32. The Occluded Gases in Coal, by S. W. Parr and P. Barker. 1909. *Fifteen cents.*
37. Unit Coal and the Composition of Coal Ash, by S. W. Parr and W. F. Wheeler. 1909. *None available.*
38. The Weathering of Coal, by S. W. Parr and W. F. Wheeler. 1909. *Twenty-five cents.*
39. Tests of Washed Grades of Illinois Coals, by C. S. McGovney. 1909. *Seventy-five cents.*
46. The Spontaneous Combustion of Coal, by S. W. Parr and F. W. Kressman. 1910. *None available.*

CHEMICAL ENGINEERING, Continued

60. The Coking of Coal at Low Temperature, with a Preliminary Study of the By-Products, by S. W. Parr and H. L. Olin. 1912. *Twenty-five cents.*

76. The Analysis of Coal with Phenol as a Solvent, by S. W. Parr and H. F. Hadley. 1914. *Twenty-five cents.*

79. The Coking of Coal at Low Temperatures, with Special Reference to the Properties and Composition of the Products, by S. W. Parr and H. L. Olin. 1915. *Twenty-five cents.*

93. A Preliminary Study of the Alloys of Chromium, Copper, and Nickel, by D. F. McFarland and O. E. Harder. 1916. *Thirty cents.*

94. The Embrittling Action of Sodium Hydroxide on Soft Steel, by S. W. Parr. 1917. *Thirty cents.*

97. Effects of Storage upon the Properties of Coal, by S. W. Parr. 1917. *Twenty cents.*

111. A Study of the Forms in Which Sulphur Occurs in Coal, by A. R. Powell with S. W. Parr. 1919. *Thirty cents.*

155. The Cause and Prevention of Embrittlement of Boiler Plate, by S. W. Parr and F. G. Straub. 1926. *None available.*

177. Embrittlement of Boiler Plate, by S. W. Parr and F. G. Straub. 1928. *None available.*

180. The Classification of Coal, by S. W. Parr. 1928. *Thirty-five cents.*

204. The Hydroxylation of Double Bonds, by S. Swann, Jr. 1929. *Ten cents.*

206. Studies in the Electrodeposition of Metals, by D. B. Keyes and S. Swann, Jr. 1930. *Ten cents.*

216. Embrittlement in Boilers, by F. G. Straub. 1930. Reprinted, 1933. *Eighty-five cents.*

219. Treatment of Water for Ice Manufacture, by D. Burks, Jr. 1930. *Sixty cents.*

228. The Corrosion of Power Plant Equipment by Flue Gases, by H. F. Johnstone. 1931. *Sixty-five cents.*

236. The Electrolytic Reduction of Ketones, by S. Swann, Jr. 1931. *Ten cents.*

238. The Catalytic Partial Oxidation of Ethyl Alcohol, by D. B. Keyes and R. D. Snow. 1931. *Twenty cents.*

252. The Catalytic Partial Oxidation of Ethyl Alcohol in the Vapor Phase, by D. B. Keyes and W. L. Faith. 1933. *Free upon request.*

253. Treatment of Water for Ice Manufacture, Part II, by D. Burks, Jr. 1933. *Forty-five cents.*

254. The Production of Manufactured Ice at Low Brine Temperatures, by D. Burks, Jr. 1933. *Seventy cents.*

261. The Cause and Prevention of Calcium Sulphate Scale in Steam Boilers, by F. G. Straub. 1933. *Free upon request.*

282. The Cause and Prevention of Steam Turbine Blade Deposits, by F. G. Straub. 1936. *Fifty-five cents.*

283. A Study of the Reactions of Various Inorganic and Organic Salts in Preventing Scale in Steam Boilers, by F. G. Straub. 1936. *One dollar.*

324. The Recovery of Sulphur Dioxide from Dilute Waste Gases by Chemical Regeneration of the Absorbent, by H. F. Johnstone and A. D. Singh. 1940. *One dollar.*

328. A Study of the Plate Factors in the Fractional Distillation of the Ethyl Alcohol-Water System, by D. B. Keyes and Leonard Byman. 1941. *Free upon request.*

CHEMICAL ENGINEERING, Continued

330. Heat Transfer to Clouds of Falling Particles, by H. F. Johnstone, R. L. Pigford, and J. H. Chapin. 1941. *Sixty-five cents.*
354. The Viscosity of Gases at High Pressures, by E. W. Comings, B. J. Mayland, and R. S. Egly. 1944. *Seventy-five cents.*
364. Steam Turbine Blade Deposits, by F. G. Straub. 1946. *Free upon request.*

CIRCULARS

12. The Analysis of Fuel Gas, by S. W. Parr and F. E. Vandaveer. 1924. *None available.*
13. The Density of Carbon Dioxide with a Table of Recalculated Values, by S. W. Parr and W. R. King, Jr. 1926. *Fifteen cents.*
19. Equipment for Gas-Liquid Reactions, by D. B. Keyes. 1929. *Ten cents.*
20. An Electrical Method for the Determination of the Dew-Point of Flue Gases, by H. F. Johnstone. 1929. *Fifteen cents.*
34. The Chemical Engineering Unit Process—Oxidation, by D. B. Keyes. 1938. *Fifty cents.*
35. Factors Involved in Plate Efficiencies for Fractionating Columns, by D. B. Keyes. 1938. *None available.*
36. A Survey of Sulphur Dioxide Pollution in Chicago and Vicinity, by A. D. Singh. 1938. *Forty cents.*
50. Bibliography of Electro-Organic Chemistry, by S. Swann, Jr. 1945. (*In press.*)

REPRINTS

2. Progress in the Removal of Sulphur Compounds from Waste Gases, by H. F. Johnstone. 1933. *None available.*
3. Chemical Engineering Problems, by D. B. Keyes. 1936. *None available.*
6. Electro-Organic Chemical Preparations, by S. Swann, Jr. 1936. *Thirty-five cents.*
18. English Engineering Units and Their Dimensions, by E. W. Comings. 1940. *Fifteen cents.*
19. Electro-Organic Chemical Preparations, Part II, by S. Swann, Jr. 1940. *Thirty cents.*
20. New Trends in Boiler Feed Water Treatment, by F. G. Straub. 1940. *Fifteen cents.*
36. Electro-Organic Chemical Preparations, Part III, by S. Swann, Jr. March, 1947. *Free upon request.*

CIVIL ENGINEERING

BULLETINS

6. Holding Power of Railroad Spikes, by R. I. Webber. 1906. *None available.*
23. Voids, Settlement, and Weight of Crushed Stone, by I. O. Baker. 1908. *None available.*
70. The Mortar-Making Qualities of Illinois Sands, by C. C. Wiley. 1913. *Twenty cents.*
80. Wind Stresses in the Steel Frames of Office Buildings, by W. M. Wilson and G. A. Maney. 1915. *None available.*
81. Influence of Temperature on the Strength of Concrete, by A. B. McDaniel. 1915. *Fifteen cents.*

CIVIL ENGINEERING, Continued

104. Tests to Determine the Rigidity of Riveted Joints of Steel Structures, by W. M. Wilson and H. F. Moore. 1917. *None available.*

108. Analysis of Statically Indeterminate Structures by the Slope Deflection Method, by W. M. Wilson, F. E. Richart, and C. Weiss. 1918. *None available.*

109. The Orifice as a Means of Measuring Flow of Water through a Pipe, by R. E. Davis and H. H. Jordan. 1918. *Twenty-five cents.*

143. Tests on the Hydraulics and Pneumatics of House Plumbing, by H. E. Babbitt. 1924. *Forty cents.*

162. Tests on the Bearing Value of Large Rollers, by W. M. Wilson. 1927. *Forty cents.*

174. The Effect of Climatic Changes on a Multiple Span Reinforced Concrete Arch Bridge, by W. M. Wilson. 1927. *Forty cents.*

178. Tests on the Hydraulics and Pneumatics of House Plumbing, Part II, by H. E. Babbitt. 1928. *Thirty-five cents.*

191. Rolling Tests of Plates, by W. M. Wilson. 1929. *Thirty cents.*

198. Results of Tests on Sewage Treatment, by H. E. Babbitt and H. E. Schlenz. 1929. *Fifty-five cents.*

202. Laboratory Tests of Reinforced Concrete Arch Ribs, by W. M. Wilson. 1929. *Fifty-five cents.*

203. Dependability of the Theory of Concrete Arches, by H. Cross. 1929. *Twenty cents.*

210. Tension Tests of Rivets, by W. M. Wilson and W. A. Oliver. 1930. *None available.*

215. Column Analogy, by H. Cross. 1930. Reprinted, 1935. *None available.*

226. Laboratory Tests of Reinforced Concrete Arches with Decks, by W. M. Wilson, 1931. *Fifty cents.*

232. Run-Off Investigations in Central Illinois, by G. W. Pickels. 1931. *Seventy cents.*

234. Movement of Piers during the Construction of Multiple-Span Reinforced Concrete Arch Bridges, by W. M. Wilson. 1931. *Twenty cents.*

239. Tests of Joints in Wide Plates, by W. M. Wilson, J. Mather, and C. O. Harris. 1931. *Forty cents.*

241. Strength of Light I-Beams, by M. S. Ketchum and J. O. Draffin. 1932. *Twenty-five cents.*

242. Bearing Value of Pivots for Scales, by W. M. Wilson, R. L. Moore, and F. P. Thomas. 1932. *Thirty cents.*

255. The Strength of Thin Cylindrical Shells as Columns, by W. M. Wilson and N. M. Newmark. 1933. *Fifty cents.*

263. The Bearing Value of Rollers, by W. M. Wilson. 1934. *Forty cents.*

268. The Mechanical Aeration of Sewage by Sheffield Paddles and by an Aspirator, by H. E. Babbitt. 1934. *Free upon request.*

269. Laboratory Tests of Three-Span Reinforced Concrete Arch Ribs on Slender Piers, by W. M. Wilson and R. W. Kluge. 1934. *One dollar.*

270. Laboratory Tests of Three-Span Reinforced Concrete Arch Bridges with Decks on Slender Piers, by W. M. Wilson and R. W. Kluge, 1934. *One dollar.*

275. The Effect of Time Yield in Concrete upon the Deformation Stresses in a Reinforced Concrete Arch Bridge, by W. M. Wilson and R. W. Kluge. 1935. *Forty cents.*

CIVIL ENGINEERING, Continued

280. The Effect of Residual Longitudinal Stresses upon the Load-Carrying Capacity of Steel Columns, by W. M. Wilson and R. L. Brown. 1935. *Thirty cents.*
286. Analysis of Flow in Networks of Conduits or Conductors, by H. Cross. 1936. *Thirty-five cents.*
287. The Biologic Digestion of Garbage with Sewage Sludge, by H. E. Babbitt, B. J. Leland, and F. H. Whitley, Jr. 1936. *One dollar.*
292. Tests of Steel Columns; Thin Cylindrical Shells; Laced Channels; Angles, by W. M. Wilson. 1937. *Fifty cents.*
295. Tests of Thin Hemispherical Shells Subjected to Internal Hydrostatic Pressure, by W. M. Wilson and J. Marin. 1937. *Thirty cents.*
296. Magnitude and Frequency of Floods on Illinois Streams, by G. W. Pickels. 1937. *Seventy cents.*
302. Fatigue Tests of Riveted Joints, by W. M. Wilson and F. P. Thomas. 1938. *Free upon request.*
304. A Distribution Procedure for the Analysis of Slabs Continuous over Flexible Beams, by N. M. Newmark. 1938. *None available.*
308. An Investigation of Rigid Frame Bridges: Part II, Laboratory Tests of Reinforced Concrete Rigid Frame Bridges, by W. M. Wilson, R. W. Kluge, and J. V. Coombe. 1938. *Eighty-five cents.*
309. The Effects of Errors or Variations in the Arbitrary Constants of Simultaneous Equations, by G. H. Dell. 1938. *Sixty cents.*
310. Fatigue Tests of Butt Welds in Structural Steel Plates, by W. M. Wilson and A. B. Wilder. 1938. *Sixty-five cents.*
313. Tests of Plaster-Model Slabs Subjected to Concentrated Loads, by N. M. Newmark and H. A. Lepper. 1939. *Sixty cents.*
317. Fatigue Tests of Connection Angles, by W. M. Wilson and J. V. Coombe. 1939. *Free upon request.*
319. Laminar Flow of Sludges in Pipes with Special Reference to Sewage Sludge, by H. E. Babbitt and D. H. Caldwell. 1940. *Free upon request.*
322. An Investigation of Rigid Frame Bridges: Part III, Tests of Structural Hinges of Reinforced Concrete, by R. W. Kluge. 1940. *Free upon request.*
323. Turbulent Flow of Sludges in Pipes, by H. E. Babbitt and D. H. Caldwell. 1940. *Free upon request.*
327. Fatigue Tests of Welded Joints in Structural Plates, by Wilbur M. Wilson, W. H. Bruckner, J. V. Coombe, and R. A. Wilde. 1941. *One dollar.*
331. Tests of Cylindrical Shells, by W. M. Wilson and E. D. Olson. 1941. *Free upon request.*
333. The Suitability of Stabilized Soil for Building Construction, by E. L. Hansen. 1941. *Forty-five cents.*
336. Moments in I-Beam Bridges, by N. M. Newmark and C. P. Siess. 1942. *One dollar.*
337. Tests of Riveted and Welded Joints in Low-Alloy Structural Steels, by W. M. Wilson, W. H. Bruckner, and T. H. McCrackin, Jr. 1942. *Eighty cents.*
338. Influence Charts for Computation of Stresses in Elastic Foundations, by N. M. Newmark. 1942. *Thirty-five cents.*
344. Fatigue Tests of Commercial Butt Welds in Structural Steel Plates, by W. M. Wilson, W. H. Bruckner, T. H. McCrackin, Jr., and H. C. Beede. 1943. *One dollar.*
350. Fatigue Strength of Fillet-Weld and Plug-Weld Connections in Steel Structural Members, by W. M. Wilson, W. H. Bruckner, J. E. Duberg, and H. C. Beede. 1944. *One dollar.*
352. Impact on Railway Bridges, by C. T. G. Looney. 1944. *One dollar.*

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360. Investigations of the Strength of Riveted Joints in Copper Sheets, by W. M. Wilson and A. M. Ozelsel. 1945. *Free upon request.*

361. Residual Stresses in Welded Structures, by W. M. Wilson and Chao-Chien Hao. 1946. *Seventy cents.*

363. Studies of Slab and Beam Highway Bridges: Part I—Tests of Simple-Span Right I-Beam Bridges, by N. M. Newmark, C. P. Siess, and R. R. Penman. 1946. *Free upon request.*

365. Joints in Concrete Pavements, by J. S. Crandell, V. L. Glover, W. C. Huntington, J. D. Lindsay, F. E. Richart, and C. C. Wiley. (*In press.*)

367. Influence Charts for Computation of Vertical Displacements in Elastic Foundations, by N. M. Newmark. March, 1947. *Free upon request.*

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2. Drainage of Earth Roads, by I. O. Baker. 1906. *None available.*

10. The Grading of Earth Roads, by W. M. Wilson. 1923. *Fifteen cents.*

11. The Oiling of Earth Roads, by W. M. Wilson. 1924. *Fifteen cents.*

18. The Construction, Rehabilitation, and Maintenance of Gravel Roads Suitable for Moderate Traffic, by C. C. Wiley. 1929. *Thirty cents.*

21. Tests of Welds, by W. M. Wilson. 1931. *Twenty cents.*

24. Simplified Computation of Vertical Pressures in Elastic Foundations, by N. M. Newmark. 1935. *Twenty-five cents.*

25. Papers Presented at the Twenty-second Annual Conference on Highway Engineering, held at the University of Illinois, February 21 and 22, 1935. 1936. *Fifty cents.*

27. Papers Presented at the Twenty-third Annual Conference on Highway Engineering, held at the University of Illinois, February 26-28, 1936. 1936. *None available.*

30. Papers Presented at the Twenty-fourth Annual Conference on Highway Engineering, held at the University of Illinois, March 3-5, 1937. 1937. *None available.*

32. Two Investigations on Transit Instruments, by William H. Rayner. 1938. *Free upon request.*

33. Papers Presented at the Twenty-fifth Annual Conference on Highway Engineering, held at the University of Illinois, March 2-4, 1938. 1938. *None available.*

38. Papers Presented at the Twenty-sixth Annual Conference on Highway Engineering, held at the University of Illinois, March 1-3, 1939. 1939. *Free upon request.*

40. German-English Glossary for Civil Engineering, by Alphonse A. Brielmaier. 1940. *Forty-five cents.*

41. Papers Presented at the Twenty-seventh Annual Conference on Highway Engineering, held at the University of Illinois, March 6-8, 1940. 1940. *Free upon request.*

42. Papers Presented at the Twenty-eighth Annual Conference on Highway Engineering, held at the University of Illinois, March 5-7, 1941. 1942. *Free upon request.*

49. The Drainage of Airports, by W. W. Horner. 1944. *Fifty cents.*

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23. Numerical Procedure for Computing Deflections, Moments, and Buckling Loads, by N. M. Newmark. 1942. *None available.*
34. Progress Report of the Joint Investigation of Methods of Roadbed Stabilization, by R. B. Peck. 1946. *Free upon request.*
38. Progress Report of the Joint Investigation of Methods of Roadbed Stabilization, by R. Smith, R. B. Peck, and T. H. Thornburn. 1947. *Free upon request.*

ELECTRICAL ENGINEERING

BULLETINS

19. Comparative Tests of Carbon, Metallized Carbon, and Tantalum Filament Lamps, by T. H. Amrine. 1907. *None available.*
25. Lighting Country Homes by Private Electric Plants, by T. H. Amrine. 1908. *Twenty cents.*
33. Tests of Tungsten Lamps, by T. H. Amrine and A. Guell. 1909. *Twenty cents.*
51. Street Lighting, by J. M. Bryant and H. G. Hake. 1911. *Thirty-five cents.*
53. Inductance of Coils, by M. Brooks and H. M. Turner. 1912. *Forty cents.*
54. Mechanical Stresses in Transmission Lines, by A. Guell. 1912. *Twenty cents.*
55. Starting Currents of Transformers, with Special Reference to Transformers with Silicon Steel Cores, by T. D. Yensen. 1912. *Twenty cents.*
61. Characteristics and Limitations of the Series Transformer, by A. R. Anderson and H. R. Woodrow. 1912. *Twenty-five cents.*
72. Magnetic and Other Properties of Electrolytic Iron Melted in Vacuo, by T. D. Yensen. 1914. *Forty cents.*
77. The Effect of Boron upon the Magnetic and Other Properties of Electrolytic Iron Melted in Vacuo, by T. D. Yensen. 1915. *Ten cents.*
83. Magnetic and Other Properties of Iron-Silicon Alloys Melted in Vacuo, by T. D. Yensen. 1915. *Thirty-five cents.*
95. Magnetic and Other Properties of Iron-Aluminum Alloys Melted in Vacuo, by T. D. Yensen and W. A. Gatward. 1917. *Seventy cents.*
138. Alkali-Vapor Detector Tubes, by H. A. Brown and C. T. Knipp. 1923. *Twenty cents.*
145. Non-Carrier Radio Telephone Transmission, by H. A. Brown and C. A. Keener. 1924. *Fifteen cents.*
147. Investigation of Antennae by Means of Models, by J. T. Tykociner. 1925. *Thirty-five cents.*
148. Radio Telephone Modulation, by H. A. Brown and C. A. Keener. 1925. *Thirty cents.*
153. The Effect of Temperature on the Registration of Single Phase Induction Watthour Meters, by A. R. Knight and M. A. Faucett. 1926. *Fifteen cents.*
161. Short Wave Transmitters and Methods of Tuning, by J. T. Tykociner. 1927. *Thirty-five cents.*
194. Tuning of Oscillating Circuits by Plate Current Variations, by J. T. Tykociner and R. W. Armstrong. 1929. *Thirty cents.*
259. Oscillations Due to Ionization in Dielectrics and Methods of Their Detection and Measurement, by J. T. Tykociner, H. A. Brown, and E. B. Paine. 1933. *Free upon request.*
260. Investigation of Cable Ionization Characteristics with Discharge Detection Bridge, by H. A. Brown, J. T. Tykociner, and E. B. Paine. 1933. *Fifty cents.*
278. Oscillations Due to Corona Discharges on Wires Subjected to Alternating Potentials, by J. T. Tykociner, R. E. Tarpley, and E. B. Paine. 1935. *Sixty cents.*

ELECTRICAL ENGINEERING, Continued

291. Flexural Vibrations of Piezoelectric Quartz Bars and Plates, by J. T. Tykociner and M. W. Woodruff. 1937. *Forty cents.*
299. Solution of Electrical Networks by Successive Approximations, by L. L. Smith. 1937. *Free upon request.*
325. Photoelectric Sensitization of Alkali Surfaces by Means of Electric Discharges in Water Vapor, by J. T. Tykociner, Jakob Kunz, and L. P. Garner. 1940. *Free upon request.*
339. Properties and Applications of Phase-Shifted Rectified Sine Waves, by J. T. Tykociner and L. R. Bloom. 1942. *Sixty cents.*

CIRCULARS

28. An Investigation of Student Study Lighting, by J. O. Kraehenbuehl. 1937. *Forty cents.*
29. Problems in Building Illumination, by J. O. Kraehenbuehl. 1937. *Thirty-five cents.*
48. Magnetron Oscillator for Instruction and Research in Microwave Techniques, by J. T. Tykociner and L. R. Bloom. 1944. *Forty cents.*

ENGINEERING PHYSICS

BULLETINS

5. Resistance of Tubes to Collapse, by A. P. Carman and M. L. Carr. 1906. *None available.*
47. Magnetic Properties of Heusler Alloys, by E. B. Stephenson. 1910. *Twenty-five cents.*
62. The Electron Theory of Magnetism, by E. H. Williams. 1912. *Thirty-five cents.*
73. Acoustics of Auditoriums, by F. R. Watson. 1914. *Twenty cents.*
87. Correction of Echoes and Reverberation in the Auditorium, University of Illinois, by F. R. Watson and J. M. White. 1916. *Fifteen cents.*
99. The Collapse of Short Thin Tubes, by A. P. Carman. 1917. *Twenty cents.*
114. Corona Discharge, by E. H. Warner with Jakob Kunz. 1919. *Seventy-five cents.*
122. The Thermal Conductivity and Diffusivity of Concrete, by A. P. Carman and R. A. Nelson. 1921. *Twenty cents.*
127. Sound-Proof Partitions, by F. R. Watson. 1922. *Forty-five cents.*
172. The Absorption of Sound by Materials, by F. R. Watson. 1927. *None available.*
173. Surface Tension of Molten Metals, by E. E. Libman. 1927. *Thirty cents.*
187. The Surface Tension of Molten Metals, by E. E. Libman. 1928. *Fifteen cents.*

MECHANICAL ENGINEERING

BULLETINS

2. Tests of High-Speed Tool Steels on Cast Iron, by L. P. Breckenridge and H. B. Dirks. 1905. *None available.*
3. The Engineering Experiment Station of the University of Illinois, by L. P. Breckenridge. 1906. *None available.*

MECHANICAL ENGINEERING, Continued

7. Fuel Tests with Illinois Coals, by L. P. Breckenridge, S. W. Parr, and H. B. Dirks. 1906. *None available.*
9. An Extension of the Dewey Decimal System of Classification Applied to the Engineering Industries, by L. P. Breckenridge and G. A. Goodenough. 1906. Revised Edition, 1912. *Fifty cents.*
15. How to Burn Illinois Coal without Smoke, by L. P. Breckenridge. 1907. *None available.*
18. The Strength of Chain Links, by G. A. Goodenough and L. E. Moore. 1907. *None available.*
21. Tests of a Liquid Air Plant, by C. S. Hudson and C. M. Garland. 1908. *Fifteen cents.*
30. On the Rate of Formation of Carbon Monoxide in Gas Producers, by J. K. Clement, L. H. Adams, and C. N. Haskins. 1909. *Twenty-five cents.*
31. Fuel Tests with House-Heating Boilers, by J. M. Snodgrass. 1909. *Fifty-five cents.*
34. Tests of Two Types of Tile-Roof Furnaces under a Water-Tube Boiler, by J. M. Snodgrass. 1909. *Fifteen cents.*
36. The Thermal Conductivity of Fire-Clay at High Temperatures, by J. K. Clement and W. L. Egy. 1909. *Twenty cents.*
40. A Study in Heat Transmission, by J. K. Clement and C. M. Garland. 1909. *None available.*
50. Tests of a Suction Gas Producer, by C. M. Garland and A. P. Kratz. 1911. *Fifty cents.*
58. A New Analysis of the Cylinder Performance of Reciprocating Engines, by J. P. Clayton. 1912. *Sixty cents.*
63. Entropy-Temperature and Transmission Diagrams for Air, by C. R. Richards. 1913. *None available.*
65. The Steam Consumption of Locomotive Engines from the Indicator Diagrams, by J. P. Clayton. 1913. *Forty cents.*
66. The Properties of Saturated and Superheated Ammonia Vapor, by G. A. Goodenough and W. E. Mosher. 1913. *None available.*
75. Thermal Properties of Steam, by G. A. Goodenough. 1914. *Thirty-five cents.*
78. A Study of Boiler Losses, by A. P. Kratz. 1915. *Thirty-five cents.*
102. A Study of the Heat Transmission of Building Materials, by A. C. Willard and L. C. Lichty. 1917. *Twenty-five cents.*
103. An Investigation of Twist Drills, by B. W. Benedict and W. P. Lukens. 1917. *Sixty cents.*
112. Report of Progress in Warm-Air Furnace Research, by A. C. Willard. 1919. *None available.*

*117. Emissivity of Heat from Various Surfaces, by V. S. Day. 1920. *None available.*

*120. Investigation of Warm-Air Furnaces and Heating Systems, by A. C. Willard, A. P. Kratz, and V. S. Day. 1921. *None available.*

130. The Reheating of Compressed Air, by C. R. Richards and J. N. Vedder. 1922. *Fifty cents.*
131. A Study of Air-Steam Mixtures, by L. A. Wilson with C. R. Richards. 1922. *Seventy-five cents.*
133. A Study of Explosions of Gaseous Mixtures, by A. P. Kratz and C. Z. Rosecrans. 1922. *Fifty-five cents.*

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*Some of the material of these bulletins is included in "Gravity Warm-Air Heating," a digest of the Warm-Air Furnace Research, published by the National Warm-Air Heating and Air Conditioning Association, Columbus, O. Price $2.00.

MECHANICAL ENGINEERING, Continued

139. An Investigation of the Maximum Temperatures and Pressures Attainable in the Combustion of Gaseous and Liquid Fuels, by G. A. Goodenough and G. T. Felbeck. 1924. *None available.*

*141. Investigation of Warm-Air Furnaces and Heating Systems, Part II, by A. C. Willard, A. P. Kratz, and V. S. Day. 1924. *None available.*

146. The Total and Partial Vapor Pressures of Aqueous Ammonia Solutions, by T. A. Wilson. 1925. *Twenty-five cents.*

149. An Investigation of the Efficiency and Durability of Spur Gears, by C. W. Ham and J. W. Huckert. 1925. *Fifty cents.*

150. A Thermodynamic Analysis of Gas Engine Tests, by C. Z. Rosecrans and G. T. Felbeck. 1925. *Fifty cents.*

157. An Investigation of the Mechanism of Explosive Reactions, by C. Z. Rosecrans. 1926. *Thirty-five cents.*

159. An Investigation of Twist Drills, Part II, by B. W. Benedict and A. E. Hershey. 1926. *Forty cents.*

160. A Thermodynamic Analysis of Internal-Combustion Engine Cycles, by G. A. Goodenough and J. B. Baker. 1927. *None available.*

168. Heat Transmission through Boiler Tubes, by H. O. Croft. 1927. *Thirty cents.*

169. Effect of Enclosures on Direct Steam Radiator Performance, by M. K. Fahnestock. 1927. *Twenty cents.*

171. Heat Transfer in Ammonia Condensers, by A. P. Kratz, H. J. Macintire, and R. E. Gould. 1927. *Thirty-five cents.*

182. Flow of Brine in Pipes, by R. E. Gould and M. I. Levy. 1928. *Fifteen cents.*

186. Heat Transfer in Ammonia Condensers, Part II, by A. P. Kratz, H. J. Macintire, and R. E. Gould. 1928. *Twenty cents.*

188. Investigation of Warm-Air Furnaces and Heating Systems, Part III, by A. C. Willard, A. P. Kratz, and V. S. Day. 1929. *Forty-five cents.*

189. Investigation of Warm-Air Furnaces and Heating Systems, Part IV, by A. C. Willard, A. P. Kratz, and V. S. Day. 1929. *None available.*

192. Investigation of Heating Rooms with Direct Steam Radiators Equipped with Enclosures and Shields, by A. C. Willard, A. P. Kratz, M. K. Fahnestock, and S. Konzo. 1929. *None available.*

200. Investigation of Endurance of Bond Strength of Various Clays in Molding Sand, by C. H. Casberg and W. H. Spencer. 1929. *Fifteen cents.*

207. The Flow of Air through Circular Orifices with Rounded Approach, by J. A. Polson, J. G. Lowther, and B. J. Wilson. 1930. *Thirty cents.*

209. Heat Transfer in Ammonia Condensers, Part III, by A. P. Kratz, H. J. Macintire, and R. E. Gould. 1930. *Thirty-five cents.*

213. Combustion Tests with Illinois Coals, by A. P. Kratz and W. J. Woodruff. 1930. *Thirty cents.*

221. An Investigation of Core Oils, by C. H. Casberg and C. E. Schubert. 1931. *Fifteen cents.*

222. Flow of Liquids in Pipes of Circular and Annular Cross-Section, by A. P. Kratz, H. J. Macintire, and R. E. Gould. 1931. *Fifteen cents.*

223. Factors Affecting the Heating of Rooms with Direct Steam Radiators, by A. C. Willard, A. P. Kratz, M. K. Fahnestock, and S. Konzo. 1931. *Fifty-five cents.*

230. Humidification for Residences, by A. P. Kratz. 1931. *None available.*

235. An Investigation of the Suitability of Soy Bean Oil for Core Oil, by C. H. Casberg and C. E. Schubert. 1931. *Fifteen cents.*

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* Some of the material of these bulletins is included in "Gravity Warm-Air Heating," a digest of the Warm-Air Furnace Research, published by the National Warm-Air Heating and Air Conditioning Association, Columbus, O. Price $2.00.

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240. The Flow of Air through Circular Orifices in Thin Plates, by J. A. Polson and J. G. Lowther. 1932. *Twenty-five cents.*

246. Investigation of Warm-Air Furnaces and Heating Systems, Part V, by A. C. Willard, A. P. Kratz, and S. Konzo. 1932. *Eighty cents.*

247. An Experimental Investigation of the Friction of Screw Threads, by C. W. Ham and D. G. Ryan. 1932. *Thirty-five cents.*

262. Flame Temperatures in an Internal Combustion Engine Measured by Spectral Line Reversal, by A. E. Hershey and R. F. Paton. 1933. *Free upon request.*

266. Investigation of Warm-Air Furnaces and Heating Systems, Part VI, by A. P. Kratz and S. Konzo. 1934. *One dollar.*

281. An Investigation of the Durability of Molding Sands, by C. H. Casberg and C. E. Schubert. 1936. *Sixty cents.*

288. An Investigation of Relative Stresses in Solid Spur Gears by the Photo-Elastic Method, by P. H. Black. 1936. *Forty cents.*

290. Investigation of Summer Cooling in the Warm-Air Heating Research Residence, by A. P. Kratz, M. K. Fahnestock, and S. Konzo. 1937. *One dollar.*

300. Pressure Losses Resulting from Changes in Cross-Sectional Area in Air Ducts, by A. P. Kratz and J. R. Fellows. 1938. *Free upon request.*

305. Summer Cooling in the Warm-Air Heating Research Residence with Cold Water, by A. P. Kratz, S. Konzo, M. K. Fahnestock, and E. L. Broderick. 1938. *Free upon request.*

318. Investigation of Oil-Fired Forced-Air Furnace Systems in the Research Residence, by A. P. Kratz and S. Konzo. 1940. *Free upon request.*

321. Summer Cooling in the Research Residence with a Condensing Unit Operated at Two Capacities, by A. P. Kratz, S. Konzo, M. K. Fahnestock, and E. L. Broderick. 1940. *Free upon request.*

342. Pressure Losses in Registers and Stackheads in Forced Warm-Air Heating, by A. P. Kratz and S. Konzo. 1942. *Sixty-five cents.*

348. Fuel Savings Resulting from Closing of Rooms and from Use of a Fireplace, by S. Konzo and W. S. Harris. 1943. *Forty cents.*

349. Performance of a Hot-Water Heating System in the I=B=R Research Home at the University of Illinois, by A. P. Kratz, W. S. Harris, M. K. Fahnestock, and R. J. Martin. 1944. *Seventy-five cents.*

351. Temperature Drop in Ducts for Forced-Air Heating Systems, by A. P. Kratz, S. Konzo, and R. B. Engdahl. 1944. *Sixty-five cents.*

355. Fuel Savings Resulting from Use of Insulation and Storm Windows, by A. P. Kratz and S. Konzo. 1944. *Forty cents.*

356. Heat Emission and Friction Heads of Hot-Water Radiators and Convectors, by F. E. Giesecke and A. P. Kratz. 1945. *Fifty cents.*

357. The Bonding Action of Clays; Part I, Clays in Green Molding Sand, by R. E. Grim and F. L. Cuthbert. 1945. *Free upon request.*

358. A Study of Radiant Baseboard Heating in the I=B=R Research Home, by A. P. Kratz and W. S. Harris. 1945. *Thirty-five cents.*

362. The Bonding Action of Clays; Part II, Clays in Dry Molding Sands, by R. E. Grim and F. L. Cuthbert. 1946. *Free upon request.*

366. Performance of an Indirect Storage Type Hot-Water Heater, by A. P. Kratz and W. S. Harris. February, 1947. *Free upon request.*

370. The Illinois Smokeless Furnace, by J. R. Fellows, A. P. Kratz, and S. Konzo. Scheduled for publication in June, 1947. *Free upon request.*

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1. High-Speed Tool Steels, by L. P. Breckenridge. 1905. *None available.*
3. Fuel Tests with Illinois Coal (Compiled from tests made by the Technological Branch of the U.S.G.S., at the St. Louis, Mo., Fuel Testing Plant, 1904-1907), by L. P. Breckenridge and P. Diserens. 1908. *Thirty cents.*
4. The Economical Purchase and Use of Coal for Heating Homes, with Special Reference to Conditions in Illinois. 1917. *None available.*
7. Fuel Economy in the Operation of Hand Fired Power Plants. 1918. *Free upon request.*
9. The Functions of the Engineering Experiment Station of the University of Illinois, by C. R. Richards. 1921. *Free upon request.*

*15. The Warm-Air Heating Research Residence in Zero Weather, by V. S. Day. 1927. *None available.*

16. A Simple Method of Determining Stress in Curved Flexural Members, by B. J. Wilson and J. F. Quereau. 1927. *Fifteen cents.*
26. Papers Presented at the First Conference on Air Conditioning, held at the University of Illinois, May 4 and 5, 1936. 1936. *None available.*
37. Papers Presented at the Second Conference on Air Conditioning, held at the University of Illinois, March 8 and 9, 1939. 1939. *Free upon request.*
44. Combustion Efficiencies as Related to Performance of Domestic Heating Plants, by A. P. Kratz, S. Konzo, and D. W. Thomson. 1942. *Forty cents.*
45. Simplified Procedure for Selecting Capacities of Duct Systems for Gravity Warm-Air Heating Plants, by A. P. Kratz and S. Konzo. 1942. *Fifty-five cents.*
46. Hand-Firing of Bituminous Coal in the Home, by A. P. Kratz, J. R. Fellows, and J. C. Miles. 1942. *Free upon request.*
47. Save Fuel for Victory. 1942. *Free upon request.*
51. Rating Equations for Hand-Fired Warm-Air Furnaces, by A. P. Kratz, S. Konzo, and J. A. Henry. 1945. *Sixty cents.*

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1. Steam Condensation an Inverse Index of Heating Effect, by A. P. Kratz and M. K. Fahnestock. 1931. *Free upon request.*
5. Essentials of Air Conditioning, by M. K. Fahnestock. 1935. *None available.*
10. Heat Transfer in Evaporation and Condensation, by Max Jakob. 1937. *Thirty-five cents.*

MINING AND METALLURGICAL ENGINEERING

BULLETINS

69. Coal Washing in Illinois, by F. C. Lincoln. 1913. *Fifty cents.*
88. Dry Preparation of Bituminous Coal at Illinois Mines, by E. A. Holbrook. 1916. *Seventy cents.*
89. Specific Gravity Studies of Illinois Coal, by M. L. Nebel. 1916. *Thirty cents.*
91. Subsidence Resulting from Mining, by L. E. Young and H. H. Stoek. 1916. *None available.*
100. Percentage of Extraction of Bituminous Coal with Special Reference to Illinois Conditions, by C. M. Young. 1917. *Ninety cents.*

*Some of the material of these bulletins is included in "Gravity Warm-Air Heating," a digest of the Warm-Air Furnace Research, published by the National Warm-Air Heating and Air Conditioning Association, Columbus, O. Price $2.00.

MINING AND METALLURGICAL ENGINEERING, Continued

113. Panel System of Coal Mining; A Graphical Study of Percentage of Extraction, by C. M. Young. 1919. *Forty cents.*
116. Bituminous Coal Storage Practice, by H. H. Stoek, C. W. Hippard, and W. D. Langtry. 1920. *None available.*
119. Some Conditions Affecting the Usefulness of Iron Oxide for City Gas Purification, by W. A. Dunkley. 1921. *Thirty-five cents.*
125. The Distribution of the Forms of Sulphur in the Coal Bed, by H. F. Yancey and T. Fraser. 1921. *Fifty cents.*
128. The Ignition Temperature of Coal, by R. W. Arms. 1922. *Thirty-five cents.*
132. A Study of Coal Mine Haulage in Illinois, by H. H. Stoek, J. R. Fleming, and A. J. Hoskin. 1922. *Seventy cents.*
144. Power Studies in Illinois Coal Mining, by A. J. Hoskin and T. Fraser. 1924. *Forty-five cents.*
151. A Study of Skip Hoisting at Illinois Coal Mines, by A. J. Hoskin. 1925. *Thirty-five cents.*
158. The Measurement of Air Quantities and Energy Losses in Mine Entries, by A. C. Callen and C. M. Smith. 1926. *Forty-five cents.*
170. The Measurement of Air Quantities and Energy Losses in Mine Entries, Part II, by A. C. Callen and C. M. Smith. 1927. *Forty-five cents.*
184. The Measurement of Air Quantities and Energy Losses in Mine Entries, Part III, by A. C. Callen and C. M. Smith. 1928. *Thirty-five cents.*
196. An Investigation of the Friability of Different Coals, by C. M. Smith. 1929. *Thirty cents.*
199. The Measurement of Air Quantities and Energy Losses in Mine Entries, Part IV, by C. M. Smith. 1929. *Thirty cents.*
217. Washability Tests of Illinois Coals, by A. C. Callen and D. R. Mitchell. 1930. *Sixty cents.*
218. The Friability of Illinois Coals, by C. M. Smith. 1930. *Fifteen cents.*
231. Accidents from Hand and Mechanical Loading in Some Illinois Coal Mines, by A. C. Callen and C. M. Smith. 1931. *Twenty-five cents.*
249. The Effects on Mine Ventilation of Shaft-Bottom Vanes and Improvements in Air Courses, by C. M. Smith. 1932. *Twenty-five cents.*
258. The Possible Production of Low Ash and Sulphur Coal in Illinois as Shown by Float-and-Sink Tests, by D. R. Mitchell. 1933. *Free upon request.*
265. Application of Model Tests to the Determination of Losses Resulting from the Transmission of Air Around a Mine Shaft-Bottom Bend, by C. M. Smith. 1934. *Free upon request.*
279. The Resistance of Mine Timbers to the Flow of Air, as Determined by Models, by C. M. Smith. 1935. *Sixty-five cents.*
285. Possible Recovery of Coal from Waste at Illinois Mines, by C. M. Smith and D. R. Mitchell. 1936. *Fifty cents.*
297. Ventilation Characteristics of Some Illinois Mines, by C. M. Smith. 1937. *Seventy cents.*
320. The Hardenability of Carburizing Steels, by W. H. Bruckner. 1940. *Seventy cents.*
359. Grain Sizes Produced by Recrystallization and Coalescence in Cold-Rolled Cartridge Brass, by H. L. Walker. 1945. *Free upon request.*

CIRCULARS

5. The Utilization of Pyrite Occurring in Illinois Bituminous Coal, by E. A. Holbrook. 1917. *Twenty cents.*
6. The Storage of Bituminous Coal, by H. H. Stoek. 1918. *Forty cents.*
31. Papers Presented at the Short Course in Coal Utilization, held at the University of Illinois, May 25-27, 1937. 1938. *None available.*

MINING AND METALLURGICAL ENGINEERING, Continued

39. Papers Presented at the Fifth Short Course in Coal Utilization, held at the University of Illinois, May 23-25, 1939. 1939. *Free upon request.*
43. Papers Presented at the Sixth Short Course in Coal Utilization, held at the University of Illinois, May 21-23, 1941. 1942. *Free upon request.*

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7. Papers Presented at the Second Annual Short Course in Coal Utilization, held at the University of Illinois, June 11-13, 1935. 1936. *None available.*
31. Principles of Heat Treating Steel, by H. L. Walker. 1944. *Fifteen cents.*

RAILWAY ENGINEERING

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11. The Effect of Scale on the Transmission of Heat through Locomotive Boiler Tubes, by E. C. Schmidt and J. M. Snodgrass. 1907. *None available.*
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23. Repeated Stress (Fatigue) Testing Machines Used in the Testing Laboratory of the University of Illinois, by H. F. Moore and G. N. Krouse. 1934. *Forty cents.*

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9. Correlation between Metallography and Mechanical Testing, by H. F. Moore. 1936. *Twenty cents.*

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25. First Progress Report of the Investigation of Shelly Spots in Railroad Rails, by R. E. Cramer. 1943. *Free upon request.*
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Page numbers of departmental groups of publications have been given on page 3.

BULLETINS

*1.—T. & A.M.
*2.—Mech. Eng.
*3.—Mech. Eng.
*4.—T. & A.M.
*5.—Eng. Phys.
*6.—Civ. Eng.
*7.—Mech. Eng.
*8.—T. & A.M.
9.—Mech. Eng.
*10.—T. & A.M.
*11.—Railway Eng.
*12.—T. & A.M.
*13.—Arch. Eng.
*14.—T. & A.M.
*15.—Mech. Eng.
*16.—Arch. Eng.
*17.—Chem. Eng.
*18.—Mech. Eng.
*19.—Elec. Eng.
*20.—T. & A.M.
21.—Mech. Eng.
22.—T. & A.M.
*23.—Civ. Eng.
24.—Chem. Eng.
25.—Elec. Eng.
26.—Railway Eng.
27.—T. & A.M.
*28.—T. & A.M.
*29.—T. & A.M.
30.—Mech. Eng.
31.—Mech. Eng.
32.—Chem. Eng.
33.—Elec. Eng.
34.—Mech. Eng.
*35.—Arch. Eng.
36.—Mech. Eng.
*37.—Chem. Eng.
38.—Chem. Eng.
39.—Chem. Eng.
*40.—Mech. Eng.
*41.—T. & A.M.
42.—T. & A.M.
43.—Railway Eng.
44.—T. & A.M.
45.—T. & A.M.
*46.—Chem. Eng.
47.—Eng. Phys.
48.—T. & A.M.
49.—T. & A. M.
50.—Mech. Eng.
51.—Elec. Eng.
52.—T. & A.M.
53.—Elec. Eng.
54.—Elec. Eng.
55.—Elec. Eng.
56.—T. & A.M.
57.—Railway Eng.
58.—Mech. Eng.
59.—Railway Eng.
60.—Chem. Eng.
61.—Elec. Eng.
62.—Eng. Phys.
*63.—Mech. Eng.
*64.—T. & A.M.
65.—Mech. Eng.
*66.—Mech. Eng.
67.—T. & A.M.
68.—T. & A.M.
69.—Min. Eng.
70.—Civ. Eng.
*71.—T. & A.M.
72.—Elec. Eng.
73.—Eng. Phys.
74.—Railway Eng.
75.—Mech. Eng.
76.—Chem. Eng.
77.—Elec. Eng.
78.—Mech. Eng.
79.—Chem. Eng.
*80.—Civ. Eng.
81.—Civ. Eng.
82.—Railway Eng.
83.—Elec. Eng.
*84.—T. & A.M.
85.—T. & A.M.
*86.—T. & A.M.
87.—Eng. Phys.
88.—Min. Eng.
89.—Min. Eng.
90.—Railway Eng.
*91.—Min. Eng.
92.—Railway Eng.
93.—Chem. Eng.
94.—Chem. Eng.
95.—Elec. Eng.
96.—T. & A.M.
97.—Chem. Eng.
98.—T. & A.M.
99.—Eng. Phys.
100.—Min. Eng.
101.—Railway Eng.
102.—Mech. Eng.
103.—Mech. Eng.
*104.—Civ. Eng.
*105.—T. & A.M.
106.—T. & A.M.
*107.—T. & A.M.
*108.—Civ. Eng.
109.—Civ. Eng.
*110.—Railway Eng.
111.—Chem. Eng.
*112.—Mech. Eng.
113.—Min. Eng.
114.—Eng. Phys.
*115.—T. & A.M.
*116.—Min. Eng.
*117.—Mech. Eng.
118.—Cer. Eng.
119.—Min. Eng.
*120.—Mech. Eng.
121.—Arch. Eng.
122.—Eng. Phys.
123.—T. & A.M.
124.—T. & A.M.
125.—Min. Eng.
126.—T. & A.M.
127.—Eng. Phys.
128.—Min. Eng.
129.—Railway Eng.
130.—Mech. Eng.
131.—Mech. Eng.
132.—Min. Eng.
133.—Mech. Eng.
134.—Railway Eng.
135.—Railway Eng.
136.—T. & A.M.
*137.—T. & A.M.
138.—Elec. Eng.
*139.—Mech. Eng.
140.—Cer. Eng.
*141.—Mech. Eng.
142.—T. & A.M.
143.—Civ. Eng.
144.—Min. Eng.
145.—Elec. Eng.
146.—Mech. Eng.
147.—Elec. Eng.
148.—Elec. Eng.
149.—Mech. Eng.
150.—Mech. Eng.
151.—Min. Eng.
*152.—T. & A.M.
153.—Elec. Eng.
154.—Cer. Eng.
*155.—Chem. Eng.
*156.—T. & A.M.
157.—Mech. Eng.
158.—Min. Eng.
159.—Mech. Eng.
*160.—Mech. Eng.
161.—Elec. Eng.
162.—Civ. Eng.
163.—Cer. Eng.
*164.—T. & A.M.
165.—T. & A.M.
*166.—T. & A.M.
167.—Railway Eng.
168.—Mech. Eng.

BULLETINS (Continued)

169.—Mech. Eng.
170.—Min. Eng.
171.—Mech. Eng.
*172.—Eng. Phys.
173.—Eng. Phys.
174.—Civ. Eng.
175.—T. & A.M.
176.—T. & A.M.
*177.—Chem. Eng.
178.—Civ. Eng.
179.—Cer. Eng.
180.—Chem. Eng.
*181.—Cer. Eng.
182.—Mech. Eng.
183.—T. & A.M.
184.—Min. Eng.
185.—T. & A.M.
186.—Mech. Eng.
187.—Eng. Phys.
188.—Mech. Eng.
*189.—Mech. Eng.
190.—T. & A.M.
191.—Civ. Eng.
*192.—Mech. Eng.
193.—Cer. Eng.
194.—Elec. Eng.
*195.—T. & A.M.
196.—Min. Eng.
197.—T. & A.M.
198.—Civ. Eng.
199.—Min. Eng.
200.—Mech. Eng.
201.—Cer. Eng.
202.—Civ. Eng.
203.—Civ. Eng.
204.—Chem. Eng.
205.—T. & A.M.
206.—Chem. Eng.
207.—Mech. Eng.
208.—T. & A.M.
209.—Mech. Eng.
*210.—Civ. Eng.
211.—T. & A.M.
*212.—T. & A.M.
213.—Mech. Eng.
214.—Cer. Eng.
*215.—Civ. Eng.
216.—Chem. Eng.
217.—Min. Eng.
218.—Min. Eng.
219.—Chem. Eng.
220.—Railway Eng.
221.—Mech. Eng.
222.—Mech. Eng.
223.—Mech. Eng.
224.—Cer. Eng.
225.—Cer. Eng.
226.—Civ. Eng.
227.—Cer. Eng.
228.—Chem. Eng.
229.—Cer. Eng.
*230.—Mech. Eng.
231.—Min. Eng.
232.—Civ. Eng.
233.—Cer. Eng.
234.—Civ. Eng.
235.—Mech. Eng.
236.—Chem. Eng.
237.—T. & A.M.
238.—Chem. Eng.
239.—Civ. Eng.
240.—Mech. Eng.
241.—Civ. Eng.
242.—Civ. Eng.
243.—T. & A.M.
244.—T. & A.M.
245.—T. & A.M.
246.—Mech. Eng.
247.—Mech. Eng.
248.—Cer. Eng.
249.—Min. Eng.
250.—Railway Eng.
251.—T. & A.M.
252.—Chem. Eng.
253.—Chem. Eng.
254.—Chem. Eng.
255.—Civ. Eng.
256.—Railway Eng.
257.—Railway Eng.
258.—Min. Eng.
259.—Elec. Eng.
260.—Elec. Eng.
261.—Chem. Eng.
262.—Mech. Eng.
263.—Civ. Eng.
264.—T. & A.M.
265.—Min. Eng.
266.—Mech. Eng.
267.—T. & A.M.
268.—Civ. Eng.
269.—Civ. Eng.
270.—Civ. Eng.
271.—Cer. Eng.
272.—T. & A.M.
273.—Cer. Eng.
274.—Railway Eng.
275.—Civ. Eng.
276.—T. & A.M.
277.—T. & A.M.
278.—Elec. Eng.
279.—Min. Eng.
280.—Civ. Eng.
281.—Mech. Eng.
282.—Chem. Eng.
283.—Chem. Eng.
284.—Cer. Eng.
285.—Min. Eng.
286.—Civ. Eng.
287.—Civ. Eng.
288.—Mech. Eng.
289.—T. & A.M.
290.—Mech. Eng.
291.—Elec. Eng.
292.—Civ. Eng.
293.—T. & A.M.
294.—T. & A.M.
295.—Civ. Eng.
296.—Civ. Eng.
297.—Min. Eng.
298.—Railway Eng.
299.—Elec. Eng.
300.—Mech. Eng.
301.—Railway Eng.
302.—Civ. Eng.
*303.—T. & A.M.
*304.—Civ. Eng.
305.—Mech. Eng.
306.—T. & A.M.
307.—T. & A.M.
308.—Civ. Eng.
309.—Civ. Eng.
310.—Civ. Eng.
311.—Cer. Eng.
312.—T. & A.M.
313.—Civ. Eng.
314.—T. & A.M.
315.—T. & A.M.
316.—T. & A.M.
317.—Civ. Eng.
318.—Mech. Eng.
319.—Civ. Eng.
320.—Min. & Met. Eng.
321.—Mech. Eng.
322.—Civ. Eng.
323.—Civ. Eng.
324.—Chem. Eng.
325.—Elec. Eng.
326.—T. & A.M.
327.—Civ. Eng.
328.—Chem. Eng.
329.—T. & A.M.
330.—Chem. Eng.
331.—Civ. Eng.
332.—T. & A.M.
333.—Civ. Eng.
334.—T. & A.M.
335.—T. & A.M.
336.—Civ. Eng.
337.—Civ. Eng.
338.—Civ. Eng.
339.—Elec. Eng.
340.—T. & A.M.
341.—T. & A.M.
342.—Mech. Eng.
343.—T. & A.M.
344.—Civ. Eng.
345.—T. & A.M.
346.—T. & A.M.
347.—T. & A.M.
348.—Mech. Eng.
349.—Mech. Eng.

BULLETINS (Concluded)

350.—Civ. Eng.
351.—Mech. Eng.
352.—Civ. Eng.
353.—T. & A.M.
354.—Chem. Eng.
355.—Mech. Eng.
356.—Mech. Eng.
357.—Mech. Eng.
358.—Mech. Eng.
359.—Min. & Met. Eng.
360.—Civ. Eng.
361.—Civ. Eng.
362.—Mech. Eng.
363.—Civ. Eng.
364.—Chem. Eng.
365.—Civ. Eng.
366.—Mech. Eng.
367.—Civ. Eng.
368.—T. & A.M.
369.—T. & A.M.
370.—Mech. Eng.

CIRCULARS

*1.—Mech. Eng.
*2.—Civ. Eng.
3.—Mech. Eng.
*4.—Mech. Eng.
5.—Min. Eng.
6.—Min. Eng.
7.—Mech. Eng.
*8.—Railway Eng.
9.—Mech. Eng.
10.—Civ. Eng.
11.—Civ. Eng.
*12.—Chem. Eng.
13.—Chem. Eng.
14.—Cer. Eng.
*15.—Mech. Eng.
16.—Mech. Eng.
17.—Cer. Eng.
18.—Civ. Eng.
19.—Chem. Eng.
20.—Chem. Eng.
21.—Civ. Eng.
22.—Cer. Eng.
23.—T. & A.M.
24.—Civ. Eng.
25.—Civ. Eng.
*26.—Mech. Eng.
*27.—Civ. Eng.
28.—Elec. Eng.
29.—Elec. Eng.
*30.—Civ. Eng.
*31.—Min. & Met. Eng.
32.—Civ. Eng.
*33.—Civ. Eng.
34.—Chem. Eng.
*35.—Chem. Eng.
36.—Chem. Eng.
37.—Mech. Eng.
38.—Civ. Eng.
39.—Min. Eng.
40.—Civ. Eng.
41.—Civ. Eng.
42.—Civ. Eng.
43.—Min. Eng.
44.—Mech. Eng.
45.—Mech. Eng.
46.—Mech. Eng.
47.—Mech. Eng.
48.—Elec. Eng.
49.—Civ. Eng.
50.—Chem. Eng.
51.—Mech. Eng.

REPRINTS

1.—Mech. Eng.
*2.—Chem. Eng.
*3.—Chem. Eng.
*4.—T. & A.M.
*5.—Mech. Eng.
6.—Chem. Eng.
*7.—Min. Eng.
8.—T. & A.M.
9.—T. & A.M.
10.—Mech. Eng.
11.—T. & A.M.
12.—T. & A.M.
13.—T. & A. M.
14.—T. & A.M.
15.—T. & A.M.
16.—T. & A.M.
17.—T. & A.M.
18.—Chem. Eng.
19.—Chem. Eng.
20.—Chem. Eng.
21.—T. & A.M.
22.—T. & A.M.
*23.—Civ. Eng.
24.—T. & A.M.
25.—T. & A.M.
26.—T. & A.M.
27.—T. & A.M.
28.—T. & A.M.
29.—T. & A.M.
30.—T. & A.M.
31.—Min. & Met. Eng.
32.—T. & A.M.
33.—T. & A.M.
34.—Civ. Eng.
35.—T. & A.M.
36.—Chem. Eng.
37.—T. & A.M.
38.—Civ. Eng.

AUTHOR INDEX

AUTHOR INDEX, Continued

AUTHOR INDEX, Concluded

CHAPTER XXVI

THE STUDENT BODY

A. THE ALL-UNIVERSITY STUDENT BODY AND ITS AFFAIRS

a. General

Early Working, Living, and Social Conditions.-In the days of the early history of the University, while Illinois was a new state, some of the dry upland prairie sod had not yet been turned, and much of the corn belt was too wet to be cultivated. Most of the people were engaged in agriculture; and since many of them were in debt for their farms, they lived exceedingly economically and usually had only the bare necessities of life. The people who lived in the villages and towns did not fare much better. Chicago had a population of less than 300 000 with comparatively few people of wealth or culture. The University was advertised as an institution for the education of the industrial classes; and consequently the students who came from these Illinois surroundings to such an institution were accustomed to hard work and self-denial, and came solely to fit themselves to get along better industrially and financially. As a rule, particularly during the first few years of the University's life, the students were much older than the usual run of college student of later years, and were much more intent and determined in their desire for an education. The great majority of the students were earnest, patient, and persevering, and had little or no time or inclination for anything except study and work.

It has been estimated that during the first three or four years, from one-quarter to one-half of the students boarded themselves. Most of them lived in the dormitory, which also contained all of the recitation rooms and laboratories. The rooms were rather small, yet many of them were occupied by two students who cooked, ate, studied, and slept there. Most of these rooms were devoid of pictures on the walls or carpets on the floor. The rent was $4.00 per term (average 12 weeks) per student. Concerning these rooms and living conditions the Third Annual Circular and Catalogue issued for the school year 1869-70 contained the following statement:

"There is in the university building about sixty private rooms for students which are rented to the students who first apply. Each room is designed for the accommodation of two students. These rooms are 14 feet long and 10 feet wide. They are without furniture, it being deemed best that the students shall furnish their own rooms. It is earnestly recommended for health's sake that each student have a separate bed. A study table, chairs, and a small coal stove, may be provided in common by the occupants of the room."

"Good private boarding houses are already springing up around the university, where either day board, or board and rooms can be obtained, with the advantage of a family circle. A boarding club is maintained by the students in the university building at a cost of from $2 to $2.50 per week. Several students have provided themselves with meals in their rooms, at an expense varying from $1 to $1.50 per week."

"To avoid unnecessary litter about the grounds, coal is purchased by the university at wholesale, and furnished to students at cost."

After June, 1880, when the dormitory was declared by the Board of Trustees as unsafe for use after it had been partially destroyed by a violent windstorm, a proportionally larger number of students lived in private residences; and this change materially improved living conditions. However, the University still maintained two small dormitories of eight rooms each,-old buildings converted to that purpose,-and some students who later became distinguished graduates "batched" in these buildings.

Many of the students earned at college all the money they spent. During the first decade while there was considerable construction in progress, the students found much remunerative employment in working in the shops, especially the "machine shop", in the erection of buildings, in the preparation of the campus grounds, and in the conduct of the work of the farm. During the second decade, however, such work was not plentiful, although a few students continued to do janitor work and other services to maintain the properties. Some walked three or four miles into the country on Saturday and did a day's work besides. Fortunately, general living conditions in Illinois had greatly improved by the 80's and there was not as many students who were dependent for a living, either partly or wholly, upon their own efforts.

There was no organized social diversion, except an occasional surreptitious stag dance in a recitation room or the chapel on halloween or Thanksgiving or during the holidays. A few students were fortunate enough to be invited to

private homes in the Twin Cities, and were greatly envied by their less fortunate friends. There were but few pranks, although it was the universal custom of all students in the dormitory, during warm weather when windows were likely to be open, to keep a wash-pitcher full of water on the window sill for the possible pleasure of pouring it upon any man below who should stick his head out of the window.

The maturity, earnestness, and industry of the students of the early days and the lack of social diversions, in a large measure compensated for the lack of resources and facilities on the part of the University; and besides the students being few in number came into intimate personal contact with the instructors, and thereby obtained guidance and inspiration that were more valuable than anything to be obtained from text-books or laboratory apparatus. Although the institution was crude and poorly equipped, and the students illy prepared, it is not clear that the early students were on the whole not as well fitted for the battle of life as their successors who lived and worked under more fortunate conditions and more pleasant surroundings.

The University's Early System of Student-Labor.-A fundamental principle in the early history of the University was that students should be required to labor a certain amount of time each day for which they should receive a comparatively small financial remuneration. During the spring and fall of the terms of 1868 they were employed on the campus, as previously mentioned, in cleaning up the grounds, constructing walks, building fences, setting out trees, etc., and on the farm in laying tile, setting out orchards, etc. The Catalogue and Circular of 1868-69[1] stated as follows in this connection:

"Practice in some form, and to some extent, is indispensible to a practical education. It is the divorcement of the theoretical and practical which renders so much of education mere book learning. To guard against this fatal defect, the trustees have directed that the manual labor system shall be thoroughly tried, and all students, who are not excused on account of physical inability, are required to labor for one to two hours each day, except Saturday and Sunday. During the autumn the labor occupies only one hour a day. The students go out in squads under their military officers, and under general supervision of members of the faculty, or superintendents of the departments.

"The labor is designed to be educational, and to exhibit the practical application of the theories taught by the text books and in the lecture room. Thus far

1. Page 15.

it has been popular among the students, several attributing to it the preservation of their health through a long term of severe study. They have already accomplished a large amount of valuable work, and are proud to point to the grounds fenced, planted with trees, and ornamented by their own labor. It is found to facilitate, rather than hinder study, and affords a much more valuable means of physical culture than any system of gymnastics.

"The labor is compensated in proportion to the ability and fidelity of each laborer, the maximum compensation being eight cents an hour. Many students voluntarily work over hours, and receive for such overwork twelve and a half cents an hour. The experience of the past confirms the belief that this union and alteration of mental and muscular effort will not only give the sound mind in a sound body, but will help to produce educated men who will be strong, practical and self-reliant, full of resource, and practical in judgment, the physical equals of the strongest, and the mental peers of the wisest; thus redeeming higher education from the odium of puny forms and palid faces, and restoring the long-lost and much-needed sympathy between educated men and the great industrial and business classes.

"It is not expected that all prejudice against work will disappear at once, or that labor will at once assume for all, its position of native dignity and honor, but we may confidently hope, if the increasing number do not render it impracticable to furnish profitable employment, finally to overcome the strongest prejudice, and render the labor system one of the most profitable features of the University, with the public as well as with the students themselves."

From the beginning, compulsory labor was a source of much thought and anxiety on the part of the University administration. It was difficult to furnish adequate or efficient supervision; and it soon became impossible to furnish labor which students could do with even fair efficiency. After a trial during the spring term only, the system broke down and was abandoned, although an attempt was still made to supply labor to such students as desired it. It was found practically impossible, however, to furnish work for many of the students; and there was no pretense that such labor had any direct educational value. The failure of the systems as an educational factor was a keen disappointment to Regent Gregory and other administrative officers.

The Catalogue and Circular of 1874-75[1] contained the following statement regarding the labor policy in effect at that time:

LABOR

"Labor is not compulsory, but is furnished as far as possible to all who desire it. It is classified into Educational and Remunerative Labor.

"Educational Labor is designed as practical instruction, and constitutes a part of the course in several schools. Students are credited with their proficiency in it as in other studies. Nothing is paid for it.

"Remunerative Labor is prosecuted for its products, and students are paid

1. Page 52.

what their work is worth. Those desiring employment must join the Labor Classes, which labor for two to four hours a day. The maximum rate paid for farm, garden and shop labor is ton cents, and for that about the buildings and ornamental grounds, eight cents per hour. Efficient students, who desire to earn more money, can often obtain work for extra hours; or they may be allowed to work by the piece or job, and thus, by diligence or skill, secure more.

"Some students, who have the requisite skill, industry and economy, pay their expenses by their labor; but, in general young men cannot count upon doing this at first, without a capital to begin with, either of skill, or of money to servo them till a degree of skill is acquired. With this, however, and with a judicious use of time during vacation, many students have been able to meet their entire expenses."

Student and Student-Faculty Relationships.-"Throughout the first decade, and for some years afterward, the University was much like a large family. The students all knew each other, and knew the faculty. 'The tie between students and faculty was strong' says Emma Jones Spence, 'almost like that of relatives. We exchanged photographs, autographs, Christmas and New Year's cards, sent flowers to each other in cases of illness or death, gave our professors presents on their various anniversaries, entertained them in our homes-those who had homes-and were often entertained by them, either by classes or in other groups'".[1]

As the number of students and faculty grew, this relationship became more formal, for there was less opportunity for association both within and without the classroom. A great deal of effort has been expended to offset this disadvantage by the formation of clubs, societies, social centers, and other facilities on or about the campus. Many of these have approached their aims in particular cases and groups, but it is still impossible for individuals to become intimately acquainted on a wholesale plan where so many thousands are involved.

Daily Chapel Exercises.-For a number of years after the opening of the University, the daily chapel exercises occupied half an hour during the morning period, and consisted of the reading of a short passage of Scripture, the singing of a hymn or a gospel song in which the students joined the choir, a prayer, and usually some remarks by a member of the faculty. In the early days, Regent Gregory usually conducted the chapel exercises; and made an address upon some topic of public interest, presented an informational talk upon some leading event in political or industrial history, or gave an inspirational discussion of the formation of

1. Historical Sketch in the Alumni Record, 1918, page XII.

character and the intellectual development of the student. His topics had a wide range, were presented with clearness and eloquence, and were esteemed highly by the students. John A. Ockerson, '73, wrote regarding these chapel talks: "Every University of Illinois student of the '70's will tell you of Dr. Gregory's morning chapel talks, those earnest, kindly appeals with their almost personal challenge to each one of us". Because in that day, the students had access to only a few newspapers, magazines, or books, these chapel talks met a real need.

Beginning in September, 1894, however, the daily assembly of all students in the chapel was discontinued, owing partly to the fact that students were widely scattered in the various buildings on the campus, and partly to the exigencies of making a program for laboratory, drafting-room, and field class exercises requiring two or three-hour periods. In addition, the increase in the number of newspapers, magazines, and other information sources made less need for a source of information such as the chapel meeting filled. Many of the early students regretted, however, that the chapel talks were no longer given.

b. STUDENT-GOVERNMENT SYSTEMS

Early Government Plan.-The Student-Government system adopted on September 3, 1870[1], afforded an outlet for student activity and an opportunity for training and self-discipline. As the plan worked out, the governing or regulatory authority, patterned after our federal system, consisted of three groups: legislative, judicial, and executive. The legislative body consisted of a general assembly elected by vote of the students; the judicial department, of a council of five, chosen from the general assembly; and the executive department, of a president and a vice-president of the Government, with an adjutant for each building and with hall sargeants for control within the buildings.

All officers were elected each term; and the caucus, the campaign, and the election were often animated. The sessions of the court usually attracted visitors from the student body; and once or twice a contest with the faculty as to the jurisdiction of the two bodies was for a few days an all-absorbing topic. The Student

1."Student Government in 1870", Alumni Quarterly, 1912, page 10.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Government was very effective in maintaining quietness and good order in the dormitory; and as long as the dormitory building also housed the University, it was a valuable organization. But when the University ceased to occupy a single building and proportionally fewer students lived in the dormitory, the anamolies in the form of students' government became apparent and much friction resulted. Politics crept in, and in June 1883, the plan was discontinued with no one mourning over its demise.

There was no honor system concerning examinations; and the Student Government exercised no authority over social activities,--possibly because there were none, at least for several years after the Student Government system was established. However later as the number of non-resident women students increased and as they found homes near the campus, social activities slowly increased.

Other forms of student administration were instituted to regulate the course and conduct of student government, all of which met with only indifferent success, until 1909, when there came into being the Illinois Union described in the next section.

The University of Illinois Union. The University of Illinois Union, Inc., one of the most comprehensive organizations on the campus, came into existence with 500 members at a mass meeting of male students held on March 3, 1909. The corporation was fostered and chartered for the purpose of the "promotion of Illinois spirit by all means possible, more especially by the erection and maintenance of a club house". In 1910 the Union sponsored homecoming, pep meetings, cap burning, dad's day, and other events of student interest. In 1913, the organization purchased the building immediately north of the Co-op on Wright Street. On January 1, 1919, the Union took over by lease the first floor of the Y.M.C.A. Building at the corner of Wright and John Streets; and two years later, it purchased the building and took over the upper floors, including the dormitory facilities. It also bought the vacant lot immediately back of the building,-the lot that faces on John Street. In order to make certain adjustments, the organization was reincorporated in 1924. In 1927, it purchased the Bradley Arcade Building adjoining the Union Building on the north.

Beginning in 1934, the University undertook to develop through a lease, the main floor of the Union Building as a Student Center, and it gradually took over the property of the Union between 1938 and 1941,-the assets of the Union amounting to some $20 000 in personal property and approximately $100 000 in real-estate equity being transferred to the Board of Trustees of the University. After the new Illini Union Building was erected, the name of the Student Center Building was changed to Illini Hall.

In 1910, the government of the Union was vested in an executive board composed of the executive officers of the organization, three faculty members, and three alumni members. The form of the control organization was changed from time to time after that as campus activities multiplied. After the Union was reincorporated in 1924, it was governed by a board of directors consisting of six students elected by the student body, four faculty members appointed by the President of the University, and four alumni members appointed by the President of the Alumni Association. In 1938,[1] the government was placed in the hands of three faculty members appointed by the President of the University, the three executive officers of the Union, a representative of the Alumni Association and one student from each of the major colleges of the University. All undergraduate men students of the University were automatically members of the Union. Since 1942 when women also became eligible for membership, the Union Board has been composed of nine students, three faculty members, one representative from the Alumni Association, the Manager of the Union Building, and the Social Director of the Union.

Student Council.-The Student Council was organized about 1910 as a subsidiary of the Illinois Union to provide as its constitution stated: "a student body which is in close contact through its members with every branch of student enterprise, and which can truly represent the student body." The organization was composed of eight seniors and seven juniors with representatives from each college and school and major activity, and had general charge of such matters as were delegated to it

1. While the new board was getting under way after 1938, the old board continued, transferring the property to the Board of Trustees of the University and liquidating this phase of the business affairs of the Union. It took about three years to bring about this liquidation.

by the executive board of the Union. It was in time superseded by the Student Senate discussed in the next section.

Student Senate.--In 1934, there was established the student self-governing organization known as the Student Senate to replace the original Student Council previously mentioned. This body, still in existence substantially the same as when it was first provided, is made up of twnety-five undergraduate student members, ten officio and fifteen elected members from the undergraduate student body,--and is assigned the duties of representing the entire sutdent group in matters affecting student interest, promoting student interest, promoting general student welfare, and exercising powers of student government conferred upon it by the University Committee of Student Affairs, an organization made up of the Dean of Men, the Dean of Women, seven other faculty members, and four of the six students on the present Student Council, a subsidiary of the Student Senate.

The Student Senate meets every two weeks during the school year, and is assisted by three faculty advisors. Its three most important committees consist of the University Dance Committee, the Elections Committee, and the Student Council that cooperates with the University Senate Committee on Student Affairs. It has committees, also, on social events, honorary organizations, extracurricular activities, general welfare, and one to nominate candidates for the Freshmen Council.

Thus, Student government, established in 1870, has continued in one form or another until the present time, serving to provide excellent opportunities for student training and development and for maintaining all the conventions and proprieties of a well-ordered society.

c. STUDENT HOUSING

General.--In the early days at the University of Illinois, students were quartered in campus dormitories and private rooming houses near the campus area as previously mentioned. As fraternities and sororities came into being here, they provided rather comfortable homes for many groups; and as the number of such organizations grew and as their housing and living conditions improved, they afforded comfortable

quarters for a substantial percentage of the student body. Then as the residence halls were constructed by the University, they furnished supplementary housing and living space for students, but unfortunately for only a relatively small ratio of the student enrollment. Finally, there came into existence the organized houses of the two independent groups, - the Men's House Plan and the Women's Group System,- that supplied home accommodations for many additional students in the undergraduate list that were interested in securing the advantages of living together in organized groups. The remainder, a majority of the student body, has lived and still lives in privately-owned boarding and rooming houses that center largely around the campus area. During rather recent years, the Board of Trustees established the Division of Student Housing under the direction of the Dean of Students, to supervise student living conditions within the University district. The purpose of this particular step was to raise the standards of living provided for such students in private homes, affording better lighting and study facilities and more wholesome surroundings in the attempt to improve the atmosphere of student life,-in other words, to permit students to attain more fully the objectives maintained by this type of educational institution.

d. STUDENT PUBLICATIONS

The Student.-In November, 1871, the undergraduate students, principally seniors, in the University began the publication of a college monthly called "The Student". The publication was not so much a newspaper as an organ for the publication by the faculty of technical or other serious and heavy scientific articles that were not, unfortunately, especially interesting to the general student body. Nathan Clifford Ricker, later Dean of the College of Engineering, was a representative on the editorial staff from the College of Engineering. Because of the nature of the articles and for other reasons, too, The Student ceased publication in December, 1873, and was soon succeeded by the Illini, described briefly in the next section.

The Illini and the Daily Illini.-In January, 1874, the Illini, a monthly student newspaper published at the rate of $1.50 a year, issued its first number. Several of the annual volumes fail to disclose the names of the editors of those early days;

but a casual examination seems to indicate that the engineering students had their pro rata representation on the editorial staff, among the contributors, and on the managing board. C. G. Elliot, c. e. '75, and S. A. Ballard, arch. '78, were two editors-in-chief.

In September, 1880, the paper began to appear twice a month, and in September 1893, once a week. It began to come out three times a week in September, 1899, and five times a week in September, 1902. In September, 1907, the name of the publication was changed from "The Illini" to "The Daily Illini", and the paper was changed in size from a four-page, five-column publication, to an eight-page, four-column paper. In September, 1908, it was expanded to eight pages for five columns each. Other changes occurred from time to time as conditions required until in 1941, it had from four to eight pages of eight columns each. During the war it, like other papers, has had to retrench somewhat.

The publication was first issued under the control of the Student Government, but when this ceased to function in 1883, the election of the editor and manager became vested in the subscribers of the paper and remained so until the faculty reorganization plan of 1911 placed it in the hands of the Board of Directors of the Illini Publishing Company, the joint board having been composed at various times of three to four faculty members and of about the same number of students, that elects editors, business managers, and other officers and staff members of student publications.

The paper maintains a membership in the Associated Press and furnishes both international and national news, and in addition, portrays a good cross-section of University and local community events. It contains all the official announcements and news of sports and University affairs gathered by a staff that now, or during normal years, at least includes over 150 students. A complete set of bound copies of the publication is on file in the University Library.

Other Student Publications.-Other student publications controlled by the Illini Publishing Company include the Illio, which is the year book; the Illinois Agriculturest, which is the publication handled by the students in agriculture; and The

Illinois Technograph, which is the student publication in engineering and which is described in some detail in a later chapter in this publication.

The advantages of such student publications consist, in addition to supplying news, professional, social, and other items of interest to the University community, in providing an opportunity for students to express opinion regarding University and other policies and to gain experience in the preparing and editing of articles for publication and in managing and directing the publication processes.

e. MILITARY TRAINING

General - From the time of the opening of the University until March 1880, military drill occupied a large place in the curricular program. All male students were required to register in classes for one hour a day for three days a week during their entire four years,-the exercises including many special and extra exhibitions for visitors. The uniforms were of gray cloth such as those worn as West Point. The trousers had a broad, black stripe down the leg. The coat was a single-breasted frock buttoned to the chin, and was provided with a standing collar and cord loops on the shoulders. The vest likewise was buttoned to the chin and had a standing collar. The buttons were gilt, medalion style, and had a sheaf of wheat surrounded with the words "Illinois Industrial University". The cap was of dark blue cloth, had vertical sides, a flat top, a narrow heavy visor, and bore in front the initials I. I. U. surrounded by a silver wreath. The uniforms were quite snappy--when new. The students were required to wear the cap all of the time, and many wore the uniforms continuously.[1]

In March, 1880, the cadet uniforms were changed from gray to blue. After that time, military drill and tactics were required only of freshmen and sophomore men students,-advanced military instruction and practice being thereafter optional for juniors and seniors, from which classes the commissioned officers were selected. After September, 1891, only two hours a week were required in the basic training course.

This two-year basic course is still required of all physically-fit men

1. The cost price of the coat and pants was from $25 to $30, and of the cap, $2.50.

students, with but few exceptions, whether or not they intend to graduate. The training includes one hour of prepared recitation work and two hours of drill a week for which the students receive one credit-hour a semester.

In 1942-43, there were six units of the Reserve Officers' Training Corps at the University, organized under the National Defense Acts of Congress of June 3, 1916, and June 4, 1920, and established here between 1919 and 1921. The Corps of Cadets consisted of an Infantry Battalion, two Field Artillery regiments, a Cavalry regiment, an Engineers' regiment, a Signal Corps Battalion, and a Coast Guard regiment. Within the limits of available facilities, a student was free to choose any branch for which his aptitude and curriculum fitted him. The courses covered four consecutive years of work,-the basic, two-year courses and the advanced two-year courses. The basic courses required three hours a week, as previously stated,-one of prepared recitation work and two of drill. Any student who completed the basic course could, upon approval of the proper authorities, elect the advanced training course, which required five hours a week,-three of prepared recitation work and two of drill. For this they received 1 1/2 hours of credit a semester which counted towards graduation. This advanced course had the further requirement that a student had to attend a military camp for a six-weeks' period during the summer, preferably between the junior and senior years. All students who chose such advanced training had to pledge themselves with the Federal Government that they would complete the course as prerequisite for graduation.As part compensation, they received pay for the time they attended school and the summer camp. Students who completed the basic courses were eligible for appointment as sargeants in the Enlisted Reserve Corps of the U. S. Army, and those who completed the advanced courses satisfactorily and attended the summer camp were eligible to receive commissions as second lieutenants in the Officers' Reserve Corps of the U. S. Army. An emergency program for training engineers and other specialists for the Army and Navy for service in World War II was instituted in 1943, as previously described. The work was restored to R.O.T.C. status, however, in the fall of 1945 after the war was ended.

In addition to providing training for a supply of young men for service with

the armed forces to meet whatever contingency may arise, military drill offers the advantage of imposing discipline and of developing certain types of leadership among students who hold considerable promise of successful achievement in the lines of their chosen professions.

f. NAVAL RESERVE OFFICERS' TRAINING CORPS

General.-On November 1, 1945, a Naval Reserve Officers' Training Corps Unit was established here, its purpose being to provide an instructional program for the training of candidates for general deck and engineering service as line officers in the U. S. Naval Reserves and for commissioned line officers in the regular Navy. Curricula were organized in three colleges,-Liberal Arts and Sciences, Commerce, and Engineering. The following arrangement of courses leading to the degree of B. S. in Naval Science in the College of Engineering was approved as the basic NROTC curriculum for all departments in the College, the requirements being that the students maintain the same level of scholastic performance that students in other departments of the College now observe in order to receive the baccalaureate degree.

CURRICULUM IN NAVAL SCIENCE IN THE COLLEGE OF ENGINEERING
(Degree: B. S. in Naval Science)

FIRST YEAR[1]

First Semester Subject:	Hours	Second Semester Subject:	Hours
NS 1	3	NS 1	3
G.E.D. 1 or 4	4	Chem. 2 or 3	3 or 4
Math. 2	3	G. E. D. 2	4
Math. 4	2	Math. 6a	4
Rhetoric 1	3	Rhetoric 2	3
Hygiene	2	P. E.	1
P. E.	1		
	18		18 or 19

SECOND YEAR

NS 2	3	NS 2	3
Chem. 4	4	Math. 9	3
Math. 7	5	Physics 1b & 3b	5
Physics 1a & 3a	5	TAM 1	2
P. E.	1	Speech 1	3
		P. E.	1
	18		17

THIRD YEAR

NS 3	3	NS 3	3
NS 4	3	NS 4	3
TAM 2	3	Language	4
TAM 3 or Dept. Prescription	3	Dept. Prescriptions	6
TAM 63 or Dept. Prescription	1	P. E.	1
Language	4		
P. E.	1		
	18		17

FOURTH YEAR

NS 5	3	NS 5	3
NS 6	3	NS 6	3
Foundations of National Power	3	Foundations of National Power	3
Written English	3	Dept. Prescriptions	8 or 9
Dept. Prescriptions	6	P. E.	1
P. E.	1		
	19		18 or 19

TOTAL - 143 to 145 hours

The degree of B. S. in the field of specialization which the students have selected in the NROTC curriculum shall be granted by the College of Engineering upon the completion of a fifth year of fully prescribed work in any department of the College within the quality requirements specified for the degree in all

1. Students entering this curriculum deficient in high school mathematics must attend the summer session immediately following their freshman year and complete the requirements of that year.

departments of the College provided the students have completed all requirements of the NROTC curriculum including courses designated by the Department under the heading of Department Prescriptions.

Administrative headquarters of the NROTC are located in the old Mathews Avenue Power Plant Building, a portion of which was remodelled for the purpose. Appropriate equipment including a modern 5-inch gun, anticraft 20-mm. guns, torpedoes, and a bridge of a small escort ship have been provided.

g. ORGANIZED ATHLETICS

General-For the first ten years, there was practically no organized athletics, except voluntary gymnasium practice by a few students in the Armory after the completion in 1871 of the Mechanical Building and Drill Hall. There were scarcely ever even any impromptu ball games. Athletics did begin to assume something of its modern aspect, however, with the formation of the Athletic Association in 1883. The first intercollegiate baseball game occurred between the University and Illinois College in the fall of 1890, and athletics began to attain real prominence in University life, then when a gymnasium instructor and athletic coach was employed,--the first football eleven being formed that year, playing its first intercollegiate game with Purdue University. The Athletic Association leased from the University that portion of the campus north of White Street for an athletic park and playground, and in 1891, it received permission to enclose the plat,-about four hundred feet square,-with a seven-foot board fence and to build a grandstand and running track, the University furnishing a small appropriation for the purpose. New apparatus was bought for the gymnasium with money raised by the students through subscriptions and entertainments.

The name of the outdoor playground was changed from Athletic Park to Illinois Field in 1896, when the field was considerably enlarged and improved. The running track was extended at that time so as to be a full third of a mile in length and remained so until 1909, when it was remodelled to become a quarter-mile track in order to allow the start and finish of races to come directly in front of the football bleachers. On March 12, 1907, the Board of Trustees gave permission to build

a new baseball grandstand on Illinois Field.

From this early beginning, regular schedules of interscholastic contests in both major and minor sports and extensive programs of intramural and recreational events for both men and women have been introduced throughout the years for the purpose of developing the physical and mental faculties of students supplementary to their regular classroom assignments. Facilities for recreation to keep pace with these schedules and programs have been provided on the campus from year to year until at the present time (1945), there is a football grounds and a splendid Memorial Stadium that has a capacity of 70 000 spectators; a baseball diamond located on Illinois Field; an ice-skating rink open from October through the winter months; the George Huff Gymnasium; the men's old gymnasium and gymnasium annex; the woman's gymnasium; numerous tennis, handball, volleyball, and squash courts; intramural play grounds; polo grounds; and a golf course.

The University became a member of the Big Ten Conference when it was organized in 1896, and has continued its connection with it to date. This association has served as a means for the scheduling of intercollegiate athletic events with neighboring schools, thereby fostering more friendly relationships with these institutions, and for the development of higher standards of athletics among the secondary schools of this region.[1]

1. "Intercollegiate athletics, intramural sports, and other athletic activities for men in the University are administered by the Athletic Association which has been under faculty control since 1891. Under its by-laws as amended in 1939, its board of directors consists of seven members, who are appointed annually by the Trustees of the University on recommendation of the President of the University. Four directors are members of the faculty, and three are non-faculty members of the Alumni Association. The officers of the Association consist of a president, vice-president, and secretary, who are elected annually by the directors from their own membership, and a treasurer and a business manager, who are also elected by the directors.

"The funds of the Athletic Association are handled under regulations adopted by the Trustees of the University, and an annual budget of anticipated income and expenditures is submitted to the Trustees for approval. Sales of tickets for athletic events are audited by a representative of the Comptroller of the University, and an annual audit of the accounts of the Association is made by a public accountant approved by the Trustees."
From 1942-43 issue of the Annual Register.

The Interscholastic Track Meet.-Of the numerous activities in which many of the students have a part, probably the one most important to the progress of the institution is the Interscholastic Athletic Meet held since 1893 at the end of a week about the middle of May, in which the students of the University through the Athletic Association, act as host to the pupils of the high schools of the State. Normally, most of the visiting high-school pupils are entertained by the University students in their fraternity, sorority, and boarding houses,-the number lodged in single fraternity houses being almost beyond belief. In later years, from 120 to 140 schools have been represented by from 700 to 800 contestants; and as each local champion is accompanied by several of his friends and schoolmates, the number to be entertained taxes the capacity of the community, but the students' organizations are such that the emergency is always met. This event has been very effective in advertising the University to the high-school pupils and their friends.

The State Basketball Tournament.-Another event that has drawn a number of high-school visitors to the campus is the State Basketball Tournament held each year about the middle of March after the sectional tournaments have been completed. These groups of young guests have been handled like those coming to the Interscholastic Track Meets and their visits have served about the same purpose so far as the University is concerned.

h. STUDENT ORGANIZATIONS AND ASSOCIATIONS

The Illinois Industrial University Telegraphic Association.-In 1874, there was organized among the students an association known as the Illinois Industrial University Telegraphic Association, devoted to the study and practice of the new art of telegraphy. There were twenty-five instruments on the line, and the central office was open all hours of the day for practice. The first annual banquet of the Association was held on November 26, 1874.

The Circular and Catalogue of 1874-75 stated: "That in connection with the Military Department, there is a Telegraph office in the new University Building, with accommodations for learners and connections with the Mechanical and Military Building, the Dormitory, and several private houses, making about three miles of

Telegraph lines. The students form an association or class, and the members join the University main line, using their own instruments in their rooms. The class appoints their own officers, inspectors, etc., and pay a small contribution for maintenance, batteries, etc. At present there are twenty-seven instruments on the line."

There is no record as to how long this organization lasted, but it is safe to assume that if it was in existence when the University changed its name, it became inactive long before amateur radio came into being to serve a similar purpose.

Literary Societies.-It is evident that the University recognized from the beginning the values that would be derived from student associations that could provide for literary and forensic activities as well as fellowship and comradeship among those prompted by the same or similar purposes and incentives, for in March, 1869, Regent Gregory "organized two literary societies and assigned every student to one or the other by reading the roll in chapel with the statement that the even-numbered students were assigned to Philomathean and the odd-numbered to Adelphic. Whereupon, the societies began to develop widely different characteristics and aims, to meet in intense rivalry, and to be, for a quarter of a century, the most potent influence in the social life of the students."[1]

After University Hall was completed in 1873, these two literary organizations had their own quarters on the top floor of that building,-Adelphic Hall being formally dedicated on December 19, 1873, and Philomathean Hall, on March 7, 1874, with addresses on both occasions by Regent Gregory.

These two men's socieities, and later also Alethenai, the women's organization, which was formed in 1871, for women had been admitted to the University in the fall of 1870, met weekly and afforded valuable practice in writing, public speaking, and debating, although the members had no help or criticism from their instructors. The Union Meetings of these societies, held once each term, during these early years, were important events in student life. Even though a boy never

1. Historical Sketch, The Alumni Record, University of Illinois, 1918, page XI.

took a young lady student to church on Sunday evening, or even walked down town with her as she went home in the afternoon, or spoke to her in classroom or laboratory, it was the written law that each member of the men's literary societies should "take a girl to Union Meeting," and the event was always dramatic--sometimes a tragedy, sometimes a comedy. During the second decade, these literary societies continued their activities, but were a much less prominent factor in University life than in the first decade. A number of other literary societies were afterwards established, one or two for men and the rest for women; but other associations for both men and women came along later which so absorbed the attention and interests of the student body that by 1940 all such societies had become inactive.

The Star Course.-The Star Lecture Course, now known as The Star Course, was organized by the Adelphic and Philomathean Literary Societies in 1891, to furnish literary, dramatic, lecture, and musical entertainments to the University community. It functioned for forty years under their supervision, until March, 1931, when its work was taken over by the University Concert and Entertainment Board, a non-profit organization created to supervise and conduct all concerts and public entertainments (except social functions) given in University buildings by professional artists for which admission is charged. There are generally six numbers provided through the course each year by persons chosen from the world's outstanding professional artists and groups. The events have been held in the University Auditorium since that building was completed in 1908, except in a few special cases when it was necessary to use the George Huff Gymnasium or one of the Champaign theaters. The management of this activity has performed a most valuable and commendable service in bringing to the University community a host of distinguished talent rated as the best in this and other lands.

Intercollegiate Debating.-Early in the first decade there was organized among the students an Intercollegiate Oratorical Association which held annual contests successively at different colleges of the State. Later, as these activities increased, an Inter-State Oratorical Association was organized. It is interesting to note that in 1888-89 an engineering student, John V. Schaefer, a mechanical

engineering senior, won first prize in the former organization and third in the latter It is more remarkable in that at that time none of the engineering students had any regular instruction in rhetoric or English, although many of them took an active part in the work of the two men's literary societies. However, as the societies had no expert critic, the benefit from such work depended mainly upon the student himself; and apparently earnest efforts put forth in this work by some students only more firmly fixed unfortunate pecularities of composition or speech. When first organized, the oratorical associations attracted some attention from the student body, but never deeply stirred more than a few; and early in the '90's, when attention turned to organized athletics, interest in oratory waned somewhat and finally both organizations became dormant.

Interest was soon revived, however, for during the 1900's there were formed a number of debating organizations, among which were the Central Debating Circle of America composed of Illinois, Iowa, Minnesota, Nebraska, and Wisconsin; the State University Debating League composed of Illinois, Indiana, and Ohio; and the Northern Oratorical League comprised of Northwestern, Oberlin College, Illinois, Iowa, Michigan, Minnesota, and Wisconsin. By 1915, the first two of these had given way to two others known as the I.M.I. Debating League representing Illinois, Minnesota, and Iowa; and the Midwest Debating League representing Illinois, Michigan and Wisconsin.

These two groups combined their interests, however, for the records show that in 1928, the University became a member of the Midwest Conference Debate League, an organization which represented the Big Nine Conference schools in this section and which since being joined by the University of Chicago has been known as the Western Conference Debate League. Through this association, the University engages in a considerable number of intercollegiate debates a year, its teams for which are chosen in competitive preliminary inter-squad debates here on the campus. For some time after this League was organized, each school debated with four other schools each year and it took two years to make a complete cycle. Later, however, the practice was changed so that now each university debates with all of the others

[illegible]

[illegible]

[illegible]

in the group at some time during each school year.

Intramural Debating. For the last several years, there has been scheduled on the campus here during the second semester a series of intramural debates open to all undergraduates except members of the intercollegiate teams. Some of these in which engineers participated are described in a later chapter.

The value to the students taking part in such extracurricular activities, lies in their opportunities for training in mental agility and in the use of the written and spoken word, and for creating a greater interest in college, University, and student affairs.

The Men's and Woman's Leagues.-The Men's League, formed about 1940, functioned as the service organization for all men students on the Urbana campus. Its objectives were to promote school spirit and loyalty, to direct general activities, and to advance the interests and welfare of men students. Its two component parts were the Interfraternity Council and the Men's Independent Ward Association, which are described briefly in following paragraphs. The Woman's League, although established much earlier than the Men's, was organized for the same general purpose as the Men's, and supervised the affairs of the Pan-Hellenic Council, the Women's Group System, and the Residence Government System. The Leagues sponsored many entertainment and social events such as stunt shows, all-University sings, dances, homecomings, dads' days and mothers' days, and recreational tournaments. In 1942, the activities of both Leagues were merged into the Student Activities Division of the Illini Union.

The Interfraternity and the Pan-Hellenic Councils.-The Interfraternity Council and Pan-Hellenic Council are self-governing bodies made up of representatives of Greek-Letter social orgaiizations for men and women respectively that supervise the general University policies and other affairs of these organizations, subject, of course, to University regulations and administration.

Men's Independent Ward Association.-University regulations permit groups of five or more men with an approved housemother to organize into the Men's House Plan to promote fellowship, scholarship, improved living and studying conditions, intramural sports, social recreation, and appreciation of moral and social standards, the Plan

serving somewhat the same purpose for independent men that fraternities do for the Greek-letter men. In 1940, there were almost eighty independent houses under this House Plan, a system maintained by the Men's Independent Ward Association, or as it was known then as the Men's Independent District Association.

Women's Group System.-Women students in the University are permitted to organize under about the same conditions as those provided for men. In 1940, there were almost fifty established houses operating under a plan known as the Women's Group System. This arrangement attempts to provide for independent women students the advantages that sororities bring to Greek-letter women. The System was originated here on the campus and has made such an excellent record for itself in the field of self-government for its group, that other universities are looking to it as a model in establishing their own organizations.

Young Men's Christian Association.-The Young Men's Christian Association, or Y.M.C.A., or "Y", as it is generally known, an undenominational religious organization of University students and faculty members, provided for the purpose of instilling into the minds of its members those Christian ideals that are essential to real leadership and success, was established here in February, 1873, Ira O. Baker being one of the charter members. The first home of the Association was in a small recitation room in old University Building which stood on what is now Illinois Field. After some months, the organization was given the use of Adelphic Society room in that same building. Later, it had its own room there. After the building was destroyed by the tornado of 1880, the Y.M.C.A. found quarters on the top floor of the old Chemistry Building (now Harker Hall); and in the spring of 1883, moved to a room on the top floor of University Hall. In 1884, the Association issued its first freshman handbook,-a practice it has maintained to date. In 1895, it moved to the second floor of University Hall into a room that was located immediately east of the main entrance. The organization bought a piece of residential property on the southwest corner of John and Wright Streets in 1899, and designated the house as the "Association House", for it was the headquarters of both the Y.M.C.A. and the Y.W.C.A. In 1903-04, the Y.M.C.A. bought a lot at the northwest corner of

John and Wright Streets immediately north of the Association House and laid plans to erect a new building. The cornerstone of the new structure was laid on June 11, 1907, by President W. L. Abbott of the University Board of Trustees. The building was completed early in 1908 and was dedicated on October 4 following. This was used for Y.M.C.A. purposes until 1917, when the building was turned over to the Federal Government for service in ground training by the School of Military Aeronautics, the Y.M.C.A. transferring to the residence of President Emeritus James,-the present Health Station north of Green Street. After the armistice, the organization moved to the Student Army Training Corps hut at the southwest corner of Wright and Green Streets. When fire destroyed this building in 1923, the Association took up temporary quarters on the main floor of the Illinois Union Building. In 1928, the Association moved into a residence formerly occupied by Professor Hopkins at the southwest corner of Wright and Chalmers Street,-its present site. It remodelled the residence, added some rooms to the building, and remained there until 1937, when it was able to erect the present structure--a three-story colonial building corresponding in architectural treatment to the neighboring buildings on the University campus.

The Y.M.C.A. provides a religious and social center for students, holds religious meetings regularly throughout the school year, and sponsors fellowship and social meetings from time for student and faculty groups. It sponsors, too, a series of Fireside Forums or discussion group meetings on vital topics of interest to the University community, in fraternity and independent rooming houses. It holds a one-week camp conference at Camp Seymour near Decatur, Illinois, for freshmen men before the opening of each school year where new students find an opportunity to meet classmates, campus leaders, and faculty members. The topics discussed at the camp include fraternity rushing, registration, the choice of a curriculum of study, employment, campus activities, churches, scholarship, and University life in general. The Y.M.C.A. offers a clearing service for student rooming houses and student employment by maintaining a complete directory of available rooms and jobs in the University community.

Young Women's Christian Association.--The Young Women's Christian Association, or Y. W. C. A., as it is commonly known, came to the campus shortly after the Y.M. C. A. and offers about the same service to women students of the University that the Y. M. C. A. does to men. Since 1899, the group has occupied property at the southwest corner of Wright and John Streets in Champaign, first in a remodelled residence and later in its present quarters,-the gift of the Honorable William B. McKinley, the utility magnate, and U. S. Senator from Illinois, known for some time as the Hannah McKinley Building and now as McKinley Hall, a structure that not only provides facilities for religious and social services, but also dormitory quarters for sixty women.

Social Fraternities.- Greek-letter social fraternities were banned from the University until September, 1891. After the ban was lifted, the organizations began to establish themselves in the campus community and to take an active part in the student life of the University. The number gradually increased throughout the years until in 1942, there were about sixty groups housing approximately 2 500 students in the University community. All of these are national organizations with chapters extending throughout the nation.

Each fraternity administers its own internal affairs under supervision of the Dean of Men and the Interfraternity Council composed of two representatives from each of the several groups. Each has its own alumni board, most of them have faculty advisors, and many of them have resident tutors who act as scholarship advisors. While they have had their difficulties, most of the organizations have served a wholesome purpose by providing comfortable homes for their members, by fostering close and lasting friendships among individual groups, by encouraging superior scholarship, by sponsoring judicious participation in extracurricular activities, and by developing the highest type of loyalty to the University.[1]

Social Sororities.-Each sorority on the campus administers its own internal affairs under the general direction of the Dean of Women and the Pan-Hellenic Council and under the immediate supervision of an alumna or other committee and a chaperon. In 1942, there were about twenty-five social sorority chapters in the University, most

1. "Your First Year at Illinois", 1942, page 37.

of them representing national associations. These groups maintain their own chapter houses, each of which serves at once as home and study and social center. In addition to promoting scholarship, these organizations encourage participation in such curricular activities as the students are able to carry without detriment to their classroom schedules and obligations, and provide opportunities for social training under competent and responsible leadership and direction.

i. STUDENT SOCIAL EVENTS

All-University Class Dances.-During each school year, the four all-University classes arrange to hold their formal dances. The Freshmen Frolic, first held in 1919, generally comes somewhere in the first semester.. The Sophomore Cotillion, given for the first time on May 3, 1895, ordinarily comes near the end of the first semester or some time during the early part of the second semester. The Junior Promenade, or Junior Prom as it is commonly known, was first given on February 5, 1894, and usually occurs late in the first semester or early in the second semester. The Senior Ball, instituted in 1886, comes toward the end of the scholastic year, usually about the last of May, and is generally scheduled as one of the events of Senior Week during the commencement period.

These functions have been so popular and so largely attended that it has been necessary to schedule them in the largest halls available on the campus.[1] For some years after 1890, these affairs were held in the old Armory on Springfield Avenue. Then, when the men's new gymnasium (renamed the George Huff Gymnasium in 1937) was constructed in 1925-26, the events were scheduled there, and have, for the most part, been held there ever since.

The students have always taken a great deal of pride in preparing for these events by engaging high-grade talent for the musical and entertainment features and by providing attractive decorations to make the settings more impressive. The University has always encouraged a reasonable participation in such wholesome events carried on under proper supervision, and has regarded them as prerequisite to a high standard of morale among the members of the student body.

[1] In 1941, eleven hundred couples attended the Senior Ball.

Military Hops. President Draper[1] had a marked influence upon the social life of the students. Early in his administration, he publicly announced that he thought the students did not have enough social opportunities. In 1896, he arranged for military hops in the armory each alternate Saturday afternoon, and put the management of these affairs in the hands of the Military Commandant, who committed the details to the student officers of the regiment. These affairs were very successful and afforded agreeable opportunities for the young men and women to meet under wholesome surroundings. The military hops were continued until the rapidly-increasing number of fraternities and sororities with their many social functions made any general University social gathering less necessary. The military hops were open to all members of the regiment; but the fraternity and sorority functions that in a sense ultimately came to take their places included only members of those organizations, and hence did not serve the young men who were not members of a fraternity.

The Military Ball.-The Military Ball, an annual event since 1898, given at first under the auspices of the Military Ball Committee and later under the student Military Council, the governing body of the Reserve Officers Training Corps, is so largely attended that its events have been scheduled in a University armory or gymnasium. It is a formal affair,-the attendants wearing for the most part military uniforms, but in a few cases civilian evening dress. For a number of years, the Ball was scheduled for the Friday night of the week in which Washington's birthday came, but in recent years, it has been held on an evening later in the semester. The event is usually staged with sufficient military decorations or appliances to give it a decidedly military air.

Other Social Events.-In addition to those previously mentioned, a number of other all-University student dances are scheduled throughout the academic year, included among which are the interfraternity dance, independent informal, and registration dances. Since the opening of the Illini Union Building, some organization schedules a dance in the Union Ball Room or in the Commons on nearly every week end during the

1. Under President Draper's influence and example, the dress suit, practically unknown in campus affairs until his day, became common in faculty and student social functions.

school year. Besides these, there are numbers of other functions of which mixers, frolics, women's teas, Homecoming, and Dads' Day and Mothers' Day events are typical. Of late years, the students attending the summer session have become more active socially, culminating their activities in the Summer Prom.

B. STUDENT ENGINEERING AND SCIENTIFIC CLUBS INCLUDING STUDENT CHAPTERS OF NATIONAL ENGINEERING SOCIETIES

General.-In the belief that extracurricular activities and associatons are potent factors in the development of the well-trained engineer, the College of Engineering has always fostered numerous organizations and enterprises which have furnished opportunity for the students to employ any extra time and energy not demanded by the strictly academic requirements of their curricula, in wholesome constructive effort. In line with this policy, there are in the College a number of student professional societies and clubs devoted to the treatment and discussion of extracurricular problems of a literary, scientific, or technical nature, auxilliary to the work of the various departments and for which the regular instructional programs cannot allot time for consideration. Several of these associatons have become affiliated with national engineering societies as branches or chapters of a parent organization. These are managed largely by the students themselves; and furnish an opportunity for stimulating greater scholastic interest in their academic work and promoting a spirit of professional consciousness through programs featuring lectures or talks by practicing engineers, papers and discussions by student members, or movies of some engineering project, and provide a normal approach to membership in the parent society itself following graduation. These organizations are described briefly in the next few pages.

a. ALL-ENGINEERING SOCIETIES

Student Branch of the American Association of Engineers.-The Student Branch of the American Association of Engineers was organized on the campus in 1919-20. The membership was between 200 and 250, and included faculty as well as students in all departments of the College of Engineering. The local chapter, like that of the national association, had as its purpose "to raise the standards of ethics of the engineering profession and to promote the economic and social welfare of engineers".

The Association held many scientific and social meetings in the early years of its organization, but became inactive about 1923 and was never rejuvenated.

b. DEPARTMENTAL TECHNICAL SOCIETIES

1. Civil Engineering

The Civil Engineers' Club.-On January 8, 1883, the Civil Engineers' Club was organized as an association of undergraduate students interested in the field of civil engineering. It was intended to serve the four-fold purpose of providing the opportunity for students to meet with the faculty outside of the classroom, to prepare papers and discuss them in open meetings, to acquaint its members with the practical phases of civil-engineering work, and to develop in them a professional spirit.

At first the Club met monthly, but later it met bi-weekly, as for example in 1891-92 it met on the first and third Saturday evenings of each month in the Club room in the Chemistry Building (now Harker Hall). Still later, as in 1907-08, it met weekly, for a circular of information regarding the College of Engineering, issued in June, 1908, contained the following statement: "The Civil Engineers' Club meets every Friday evening for the discussion of topics of engineering interest, by members of the club or by practicing engineers. Students in civil or municipal and sanitary engineering are eligible to active membership."

At the early meetings, faculty or student members presented papers prepared by them for the occasion on some topic of current interest along engineering lines. The most outstanding of these papers were printed in 1886-87 in a volume entitled "Selected Papers of the Civil Engineers' Club". This practice was continued for the next three years and these four volumes became the first four of the current Illinois Technograph series. The entire expense of publication was borne by students and the advertisers. Many of these articles in these early volumes were mentioned in the engineering journals and not a few were reprinted in the technical press. The civil engineering students of that day were very proud of the publication.

The proceedings of the Club began to change somewhat about 1900, however, when the organization, instead of having its programs consist largely of papers prepared and read by its own members, began to invite speakers of note to address

it on some phase of engineering development. During 1907-08, for example, seven persons representing as many different interests, spoke before the Club on problems relating to their chosen work. As early as 1911, practically all programs consisted of talks or lectures by outside speakers. In some ways, this was an unfortunate turn, for the training acquired in preparing papers and participating in discussions served a very useful purpose besides affording knowledge in some particular field of engineering practice. The change was due, in part, no doubt, to the crowded condition of the curriculum and to the growing importance given to social and athletic events. The Club continued an active existence, even though it changed its program policy, until the early part of 1914-15, when its name was changed to Civil Engineers' Society. The name was again changed in 1921, when it became the Student Chapter of the American Society of Civil Engineers. Some consideration of the activities of this group is recorded in the following paragraphs.

Student Chapter of the American Society of Civil Engineers.-As previously stated the Civil Engineers' Club became the Student Chapter of the American Society of Civil Engineers in 1921 according to plans formulated by the national organization of the American Society of Civil Engineers, whereby each of the recognized engineering schools of the country could have a student chapter. This arrangement carried provisions for student subscriptions to the Proceedings of the parent Society and to Civil Engineering, the technical magazine published monthly by the organization.. The purposes of the organization, not essentially different from its predecessor, is to present to the student some of the practical problems in the field of civil engineering, and to develop in him a professional point of view; to provide for and foster a fraternal spirit among the students specializing in civil engineering; to familiarize the students with the purposes, functions, parlimentary proceedings, and ethics and objectives of his professional engineering society; and to encourage, promote, and support student publications and the other professional and social activities of the College of Engineering.

The Student Chapter seeks to bring to the students in the University the foremost engineers and educators in the United States to speak of their experiences,

and to express their ideas and ideals at the meetings of these young men. In this connection, the organization has made an outstanding contribution to the University's educational program and prestige, for by inviting these men to the campus, the students have profited by the unusual programs, and the speakers have been able to observe the excellent facilities provided by the University for the training of the young engineers which must someday be their successors.

2. Mechanical Engineering

The Mechanical Engineering Society.--The Mechanical Engineering Society was organized on November 8, 1883, as an association of undergraduate students interested in mechanical engineering. It held its meetings monthly at first, but semi-monthly later as for example in 1891-92 it met on the second and fourth Saturday evenings of each month in the Society rooms in the Chemistry Building (now Harker Hall). The organization united with the Civil Engineers' Club in publishing Volume No. 5 of The Illinois Technograph series,--the successor to the Selected Papers previously mentioned.

The Mechanical and Electrical Engineering Society.-In 1891-92, the Mechanical Engineering Society became the Mechanical and Electrical Engineering Society; but on March 25, 1904, the Electrical Engineering Society formed its own organization; and the mechanical engineering students reorganized on October 7, 1904, to establish the Mechanical Engineering Society again.

The Mechanical Engineering Society again.-As previously noted, after the electrical engineering students formed their own association in 1904, the students in mechanical engineering created an organization of their own called the Mechanical Engineering Society,-the same name as previously used.

The purpose of the Society was to bring speakers of note in the engineering profession, either in industrial or educational work, to the University, and to interest and unite students in some activity outside the classroom.

A circular of information regarding the College of Engineering issued in June 1908, contained the following statement: "The Mechanical Engineering Club meets on the second and fourth Friday evenings of each month. All students

pursuing mechanical engineering studies are eligible to membership. Papers relating to subjects of interest to members are presented and discussed at each meeting."

Student Branch of the American Society of Mechanical Engineers.-At the close of the school year 1908-09, a Student Branch of the American Society of Mechanical Engineers was formed at the University. The object of the new organization was to read and discuss papers presented before the parent society, as they were published in "The Journal", - the official organ of the Society. The Mechanical Engineering Society and this Student Branch merged during the first part of 1911-12 and kept the name of the latter organization. The new constitution of the Society provided that active members should be chosen from the two upper classes and that associate members should be taken from the two lower classes.

Meetings of the Student Branch were held every two weeks in the Mechanical Engineering Laboratory. The programs handled by the student officers, included talks by student members, faculty members, or outside speakers. Moving pictures also constituted a portion of the program. The Student Branch sponsored a smoker for students and faculty in mechanical engineering at the beginning of each year.

The purposes[1] of the Student Branch were as follows: to give the student some acquaintance with the practical side of the field of mechanical engineering; to furnish him with the principal publication of the Society and to keep him in touch with engineering progress; to develop the students initiative and ability to speak in public, and to familiarize him with the parlimentary procedure and organization of learned societies; to enable the student to establish fraternal contact with his fellow students in engineering and to meet older men actively engaged in mechanical-engineering practice; and to permit him to attend as a welcome guest the general meetings of the Society.

In the fall of 1932, the local student branch of the American Society of Mechanical Engineers was reorganized in accordance with the new student-branch plan which was established by the parent society, and which was intended to include all of the engineering schools of the country.. Under this plan the student, upon payment of $3 annual dues to the parent Society, becomes a student member of the

1. The Technograph, October, 1931, Page 13.

national society, and upon graduation is automatically transferred to the grade of Junior Member, with suspension of the first year's dues. In addition, the student member receives a subscription to Mechanical Engineering for the school year. Under this plan the local student branch is reimbursed to the extent of $25 for legitimate expenses of meetings, etc.; and mileage is paid for one member as a delegate to the annual meeting.

In 1932-33, there was organized or established an Annual Midwest Student Conference as a new feature of the student-branch policy, in which students of the local branches should present, in competition for prizes, papers of their own production. The first Conference was held in Chicago on April 28-29, 1933. Others have been held in the years since either in Chicago or at some point nearby, with students from midwest engineering schools competing. In 1940, sixteen schools were represented.

3. Architecture

Architects' Club or Architectural Club.-The Architects' Club was organized on January 23, 1891, as an association of undergraduate students in the Department of Architecture. At first the Club held its meetings on alternate Saturday forenoons in one of the architectural rooms on the top floor of University Hall. The organization continued with its meetings, for a circular of information regarding the activities of the College of Engineering, issued by the University in June, 1908, contained the following statement.. "The Architects' Club meets once in two weeks to consider current topics of architectural interest and subjects connected with the study of architectural history. All students pursuing architectural studies are eligible to membership. This club is a member of the Architectural League of America,[1] and contributes to its annual exhibition in the principal cities of the Unites States."

In 1911-12, the name of the organization was changed to Architectural Club. About that time, too, its requirements for membership were raised, for the 1914 copy of the Architectural Year Book stated that only those students in the Department of

1. The Architects' Club became a member of the League about 1905, being the first student local to join the national society.

Architecture whose scholarship grades were 75 per cent or above were eligible to join.

Among other activities, the students in the Architectural Club publish and issue about May each year the "Architectural Year Book". The material in this publication represents the student work of the school year and forms a valuable record of the courses as offered. This group dropped out of the College of Engineering when Architecture became a part of the College of Fine and Applied Arts in 1931.

4. Electrical Engineering

Electrical Engineering Society.-The Electrical Engineering Society became a distinct organization on March 25, 1904, when the Mechanical and Electrical Engineering Society dissolved to become two separate organizations, as previously stated. The Electrical Engineering Society held frequent meetings in which both faculty members and students took an active part. It usually gave an open meeting early in the school year to which all students interested in electrical engineering were invited. The event generally wound up with refreshments of some sort, frequently doughnuts and cider. The purpose of the organization was to stimulate extra-curricular activities among students interested in electrical engineering.

A circular of information regarding the activities of the College of Engineering, issued in June, 1908, contained the following statement: "The Electrical Engineering Society is a student organization open to any student interested in electrical work. Its primary object is to bring together all electrical students for the discussion of topics of current interest. The society maintains a technical reading room in the electrical laboratory."

Student Branch of the American Institute of Electrical Engineers.-During 1930-31, the Electrical Engineering Society was disbanded and a new organization was established as a Student Branch of the American Institute of Electrical Engineers in accordance with plans of the national organization to have such a student association in each engineering school of recognized standing. As an affiliate of the national organization, the student branch could discuss papers presented at the national meetings as well as those of their own, thereby affording more attractive and instructive

programs. Besides, in allowing the students to align themselves with their parent society, they could learn more of its purposes and objectives, follow its achievements with increased interest, and develop a professional spirit that would inspire to greater effort in classroom performance.

5. Ceramic Engineering

The Ceramics Club.- The Ceramics Club, which began in 1907, was the first organization sponsored by students interested in ceramics. Although the enrollment was small, the students in the newly-organized Department of Ceramics saw the need of an organization that would promote the spirit of professional brotherhood among the members of the group. The Club grew in strength and numbers through the years following and contributed through business and professional meetings, smokers, and other get-togethers towards the development of a greater interest in this particular field.

The members of the Ceramics Club prepared a petition and presented it to the American Ceramic Society at its meeting in Cleveland in 1915-16 to form the "Illinois Student Branch[1] of the American Ceramic Society". The petition was granted and the organization was formed as outlined in the following paragraph.

Student Branch of the American Ceramic Society.-As previously stated, the Ceramics Club was superseded by the Illinois Student Branch of the American Ceramic Society, according to plans adopted by the national organization to have a student branch in each school of recognized standing that maintained a curriculum in ceramics or ceramic engineering. This society was formally installed on the evening of December 7, 1916, at the time of the dedication of the Ceramics Building, the installation exercises being in charge of L. E. Barringer, President of the American Ceramic Society. The Student Branch started with a membership of 25,-all students in the Department of Ceramic Engineering. The membership in 1927-28 was 35, while in 1931,- it was 78 out of an enrollment of 78 undergraduates in ceramic engineering.

1. The purpose of forming these student branches in schools offering regular curricula in Ceramics was intended to stimulate interest in research and in activities of the society. The members of the student branches were not required to pay dues to the parent organization, but did have the privilege of purchasing the Transactions at the same rate as Associate Members.

The Student Branch sponsors smokers and get-together meetings for the students and staff. It usually holds about ten or twelve meetings a year with some programs carried out by students and some by faculty members and visitors. Many prominent men in industry give talks and addresses at these meetings, while some of the sessions include movies portraying some phase of the ceramic industry. The outstanding event of the year is the "pig roast", first established in December, 1923, when it was held in the kiln house. In later years the functions have been held in off-campus quarters. For example, it was held on May 18, 1937, in the Southern Tea Room with about 120 persons attending. The dinners are followed by lectures given by men prominent in their particular profession. In the spring of 1937, the organization published a 40-page year book called "The Illinois Ceramist." The publication, continued in one form or other to date, gives an interesting account of the activities of the Society and other information regarding the affairs of the department. For example, the issue appearing in the second semester of 1936-37 contained pictures of the February, 1937, and the June, 1937, graduates and the candidates for graduation in February, 1938. During the years 1936-37 and 1937-38, the students of the Society published a weekly called "Raw Materials", a 8 1/2 inch by 11 inch typed broadside which good-naturedly described the foibles of students and faculty. About 1937-38, the organization started the custom of staging a dance for ceramic students called "The Ceramic Ruckus". About 125 couples attended in 1936-37, practically all the men being connected with the department in some capacity as members of the student body or of the teaching and research staff.

The prime purpose of the organization is to foster a spirit of brotherhood among the students and to bring about closer contacts between students and the faculty, students of different classes, and students and professional men of the field.

6. Mining and Metallurgical Engineering.

Mining Society.-The Mining Society of the University of Illinois was founded in 1910 as an affiliated Student Branch of the American Institute of Mining and Metallurgical Engineers, adopting as a pin an emblem consisting of a crossed pick

and hammer. The Society included all students in the Department of Mining Engineering and held regular semi-monthly meetings,-membership being open to freshmen as well as upper classmen. At these meetings, there were talks by student members, by faculty members, and by outside speakers. Motion pictures were frequently shown. Many of these meetings were held at the home of Professor Stoek while he was Head of the Department of Mining Engineering. The membership was small, for the enrollment was small, but practically every man in the department attended the meetings.

Mineral Industries Society Affiliated with the American Institute of Mining and Metallurgical Engineers.-In 1933-34, the parent organization of the American Institute of Mining and Metallurgical Engineers appointed a special committee to consider the relationships of its affiliated student societies in the effort to improve those relationships and to increase interest and activity among those groups. In the fall of 1934-35, the committee presented a standard form of constitution and by-laws for all these affiliated societies to adopt, in substance at least, requiring them to submit their new constitution and by-laws for approval if they were to have continued recognition. The new plan required a faculty sponsor and a field counseler.

As a result of this action, there was a revival of interest throughout the field when branches began to affiliate and to take on new life. The Illinois unit joined the procession, its name being changed from Mining Society to Mineral Industries Society so that students registered in metallurgical engineering as well as in mining engineering could join. In 1939-40, there were 65 members of junior and senior grade here. These included both mining and metallurgical engineering, although metallurgical engineering are dominated in numbers.

7. Railway Engineering.

Railway Club.-The University of Illinois Railway Club was organized on February 19, 1912, with student membership in Railway Engineering and in Transportation and Railway Traffic and Accounting in the Department of Economics. This organization started with a membership of about forty, and held its first meeting on Saturday evening, March 16, 1912, when Dean Goss spoke on the subject of steel car wheels. The usual programs in after years included talks by students, faculty, and outside

speakers; and still later quiz programs and moving pictures became the principal features. The organization served to bring together students registered in the various phases of railway work and to stimulate their interest in railway problems. The Club became dormant within a short time after the Department of Railway Engineering was discontinued in 1940.

8. General Engineering

Illinois Society of General Engineers.--The Illinois Society of General Engineers, a local association, was established in 1924 by a group of undergraduate students enrolled in the curriculum of General Engineering for the purpose of promoting a greater interest in this particular field and of serving in the advancement of the extracurricular activities of the College of Engineering. The organization holds a number of meetings throughout the academic year with programs featuring addresses given by faculty or outside speakers or papers presented by student members of the Society. Frequently, the students of this group join with others within the College in scheduling a moving-picture or other program of general interest to the student body.

9. Physics

General.-The American Physical Society has never adopted the plan of establishing student chapters in the schools and colleges of the country as the professional engineering groups have done. There is, however, a local organization called the Engineering Physics Society that operates here something like student chapters; and its work is described briefly in the following notes.

Engineering Physics Society.-The Engineering Physics Society, an undergraduate association, was formed in 1930-31. The aims of the organization as formulated at that time were to fill a fraternal need by allowing the members of the growing student group in the new curriculum in Engineering Physics to become more closely acquainted with one another and the faculty; to hold regular meetings for their educational or instructional value; and, incidentally, to assist in staging the biennial Electrical Engineering Show. During normal times, meetings are held throughout the academic year with programs featuring addresses by members of the faculty or other guest

speakers, and talks and papers by the student members themselves.

10. Agricultural Engineering

Student Branch of the American Society of Agricultural Engineers.--The Illinois Student Branch of the American Society of Agricultural Engineers was organized in 1922. Its stated objective is "to promote directly and indirectly the interests of the students in agricultural engineering, particularly as these interests relate to their professional advancement and to the parent society."

Like other student organizations, the Student Branch has taken part in many programs of University affairs, some of them being in both the College of Engineering and the College of Agriculture. It has been represented on the Engineering Council as well as the Agricultural Council, and has been interested in the programs of the two college groups. The organization still active in 1945, has held regular meetings throughout each academic year since it was first installed, in some instances speakers being brought in from outside, but in most instances the students themselves carrying on their own programs. The student membership of this group has assumed responsibility for certain portions of events scheduled in connection with the Student Engineering Exhibit and the annual meeting of Farm and Home Week. During the annual meeting of the American Society of Agricultural Engineers held here in 1937, the organization contributed a special student agricultural engineering booklet called "The Student Agricultural Engineer", a publication of about seventy pages, carrying some articles describing particular phases of University work, and others presenting problems of special interest to agricultural engineers.

II. AERONAUTICAL ENGINEERING

Student Branch of the Institute of the Aeronautical Sciences.--The Student Branch of the Institute of the Aeronautical Sciences was organized at the University here in the fall of 1945, all students taking courses in Aeronautics being eligible for membership. The aim of the Institute is to bring together at its monthly meetings all students interested in this particular field in order to promote closer personal relationships between those having a common purpose, to afford opportunity for discussion and exchange of experience, and to bring to the campus speakers of note engaged in some phase of work involving the aeronautical sciences.

Student Membership in Engineering Societies.-The membership of the various engineering societies and clubs in 1938-39 as given by The Technograph[1] were:

Student Chapter of the American Society of Civil Engineers	172
Student Branch of the American Society of Mechanical Engineers	160
Student Branch of the American Institute of Electrical Engineers	128
Student Branch of the American Ceramics Society	70
Mineral Industries Society	67
Railway Club	9
Society of General Engineers	22
Engineering Physics Society	22
Student Branch of the American Society of Agricultural Engineers	27

C. HONOR SCHOLASTIC SOCIETIES AND FRATERNITIES

a. ALL-UNIVERSITY ORGANIZATIONS

General.-Election of students to membership in honor scholastic societies and fraternities affords a means for recognition of their high scholastic attainments and leadership, and for association and fellowship of those having mutual or parallel interests; and the possibility of such election, serves to stimulate certain grades of students to strive for higher standards of scholarship and for greater achievement in their curricular and extra-curricular activities.

There are two main all-University national collegiate honor organizations on the campus which choose their personnel without discrimination as to departmental affiliation, to which engineering students are eligible for membership, viz: Phi Kappa Phi and Phi Eta Sigma. Engineers are also eligible for election to another all-University society which limits its membership to those enrolled in departments of pure and applied science, viz: Sigma Xi. The organizations are described briefly in the following sections.

Phi Kappa Phi.- The Honor Society of Phi Kappa Phi, founded at the University of Maine in 1897, was installed at the University of Illinois in 1933. It was organized for and dedicated to "the purpose of promoting scholarship among American

1. September, 1939, page 10

college students. Recognizing the equality of all branches of knowledge, it seeks to foster learning in competition with numerous attractive and conflicting interests affecting the modern every-day life of the undergraduate, by offering him membership on an equal basis with members of the faculty. Through meetings of the two factors, it aims to promote good feeling, and high ideals among students in their personal college relationships. These meetings, it is hoped, will also help to overcome the decentralizing tendencies of separate school emphasis in the larger institutions.[1] The organization holds two initiations a year, choosing its members from the upper three per cent of the various schools and colleges on the Urbana campus.

Sigma Xi.-A chapter of Sigma Xi, national honor scientific society, established at Cornell University in 1886, was installed at the University of Illinois on May 16, 1904. Its membership is made up of such individuals on the faculty as have demonstrated their ability to undertake original investigations in problems of pure and applied science and of such graduate and undergraduate students as have maintained high scholastic standards and have shown considerable promise of ability to carry on research work. The organization here usually holds six or eight meetings throughout the academic year at which some person who has achieved eminence in some branch of scientific learning, presents a discussion of the problem upon which he is personally engaged or a summary of the work in progress in his particular field. There are generally two initiations a year, both graduate and undergraduate students being eligible for election. Only a limited number of the outstanding members of each group, however, are recommended for membership by the several departments authorized to propose nominations.

Phi Eta Sigma.-Phi Eta Sigma, national honorary freshmen society, organized to stimulate high scholarship attainment among men students of freshmen grade, in all departments of American Universities was founded on the campus here on March 22,1923, Thomas Arkle Clark, Dean of Men, having been the prime mover in sponsoring the association. "His observation led him to conclude that college students who strive for academic honors - reached by a few in their junior year, but generally

1. Phi Kappa Phi Journal, March, 1938, page 2..

in their last year in college - should have recognition before that time."[1] The society is strictly honorary, those students being eligible for membership who have scholastic averages either of 4.5 for the first semester of the freshman year or of 4.5 for the entire year.[2] The engineers have usually had their full quota in membership in the organization. For example, in 1927-28, twenty-seven engineers made membership in it, and in 1928-29, nineteen out of the twenty-seven freshmen initiated were engineers. At the end of 1944, chapters had been installed in forty-eight colleges and universities throughout the United States.

b. ALL-ENGINEERING HONOR FRATERNITIES

General.-Recognition of the scholastic achievements of engineering students is given also through election to membership in the honorary organizations of Tau Beta Pi and Sigma Tau. Some description of these organizations is appropriate, therefore, in this connection.

Tau Beta Pi. - Tau Beta Pi, the first honorary engineering fraternity organized in this country and the first of any such engineering society to come to the University of Illinois, was founded at Lehigh University in 1885 for the purpose of recognizing superior scholarship among undergraduate engineering students that showed promising qualities of leadership, integrity of purpose, and character; of awarding attainments among the alumni; and of promoting a spirit of liberal culture in the engineering schools of the country. Illinois Alpha was installed here on June 2, 1897. Election to membership has always been made by its members upon the basis of scholarship,-not more than one-eighth of the junior class being elected at the end of the junior year, and not more than one-eighth of the senior class at the end of the first semester of the senior year. The student of highest scholastic rank in the sophomore class is also elected. This policy has resulted in the initiation of about thirty members a year, usually about fifteen juniors are taken in near the end of the second semester and about the same number of seniors at the end of the first semester

1. The Forum of Phi Eta Sigma, February, 1931, page 6
2. This latter provision was made so that students whose averages were below 4.5 for the first semester, but whose grades were high enough during the second semester to make an average of 4.5 for the year, could be eligible.

The members of the fraternity compute the standing of candidates from the College records,--a practice that has always seemed to be done accurately and honestly. The organization formerly held public meetings in the interest of good scholarship and high ideals, and both directly and indirectly it has helped to improve intellectual and social standards among the students in the College of Engineering. While many of the chapters in other schools maintain their own fraternity houses, it has not seemed advisable to do so here because there are so many social fraternities to which many of the students already belong when they become eligible for membership in Tau Beta Pi.[1]

Sigma Tau.-On February 27, 1914, Theta Chapter of Sigma Tau, a national engineering fraternity founded at the University of Nebraska in 1904 for the purpose of promoting good scholarship and fellowship and of inspiring higher ideals in the mind of engineering students, was formally installed at the University of Illinois. Candidates are chosen on the strength of their qualifications as promising engineers as shown partly by their scholastic records, partly by their leadership as evidenced by their activities in other organizations, partly by their initiative as demonstrated by their capacity to apply their engineering knowledge to the solution of practical problems, and partly by their sociability trends,- a measure of their public spirit. The membership is restricted to juniors and seniors registered in the College of Engineering and isselected from those having a "B" grade (4.0) or better. The organizations hold regular meetings throughout the year and an initiation session for about twenty pledges each semester. Like Tau Beta Pi, the fraternity does not maintain a chapter house because so many of its members are chosen from social fraternities already located in the campus area. In addition, the founders of Sigma Tau frowned upon the idea of a chapter house lest the social requirements become of paramount interest to the neglect of the scholastic standards. Sigma Tau is not considered a competitor of Tau Beta Pi, many of the faculty and students being members of both groups.

1. The Chapter here did maintain a house until World War I, but on account of the inherent difficulties involved in seduring membership, it decided to discontiue the practice..

c. DEPARTMENTAL HONOR FRATERNITIES

General.-In addition to the all-engineering fraternities, there have been established in several of the departments of the College, honor organizations, usually with national affiliations, that elect to membership outstanding upper classmen of the departments as a means of rewarding their scholastic attainments. These are described in the following paragraphs.

Eta Kappa Nu.-Eta Kappa Nu, honorary electrical-engineering society, was founded at the University of Illinois on October 28, 1904. The organization has for its purpose the bringing together into a closer union for mutual benefit, students, faculty, and others in the profession of electrical engineering, who, by their attainments in college or in practice have manifested a marked ability in their chosen fields. A tablet mounted on a large boulder near the front entrance of the Electrical Engineering Building on Burrill Avenue, bears the names of the ten students who founded the society. The organization, still active in 1945, holds several meetings during the academic year, some of which are technical and some social. The members of the group have been active in promoting A.I. E. E. interests and such other activities as the Electrical Engineering Show and the Engineering Open House. The Society has had a remarkable growth,--it now includes thirty-six student chapters and several alumni associations throughout the country.

Keramos.--Keramos, the Greek term for ceramics, was organized on January 26, 1915, as an honor society by a small group of students registered in the Department of Ceramic Engineering at the University of Illinois, for the purpose of promoting fellowship among students in the department. It was the first ceramics fraternity to be established in the United States, the second chapter having been located at Ohio State University, and later chapters at other institutions offering work in ceramics. The qualifications for election to membership, which is open to junior and senior students who are registered in the Department and who have an average above 3.0, are based partly on scholarship and partly on personal characteristics and probable success in professional work after leaving the University. The student membership generally runs from 20 to 30, with 7 or 8 from the faculty. The

organization is still active and usually holds about eight or ten meetings a year with both social and scientific programs.

Pi Tau Sigma.-The parent chapter of Pi Tau Sigma, honorary mechanical-engineering fraternity, was founded by a group of junior and senior mechanical-engineering students at the University of Illinois in the spring of 1915-the original charter having been granted by the University on March 16. During the school year 1915-16, the organization affiliated with a similar society at the University of Wisconsin known as Pi Delta Phi.[1] The local chapter accepted the ritual and coat of arms of the Wisconsin society, but it retained its own name, constitution, and badge. The purpose of the fraternity is to emphasize through its membership, the high ideals of the mechanical engineering profession, to stimulate student effort in the various departmental activities, to promote the mutual welfare of its members, to develop a spirit of a congenial friendship among the students and a better acquaintance and mutual understanding between the students and the faculty. Membership is confined to junior and senior students registered in mechanical engineering,-selection being based upon scholastic standing, faculty rating, and member opinions.

The group still active in 1945 holds a number of business, professional, and social meetings throughout the academic year. Generally a short talk is delivered by a faculty member or by a prominent engineer from industry as a feature of the meetings. Smokers, picnics, dinners, and banquets, at which students and faculty can become better acquainted, are occasionally scheduled.

Gargoyle.--The Beta Chapter of the Gargoyle Society, an honorary fraternity founded at Cornell University in 1910, was established at Illinois in January, 1917. It chooses its members from students in Architecture on the basis of high scholastic attainments and proficiency in this particular field. Each year, Gargoyle plans to have an open meeting for students in the Department of Architecture at which time members of the faculty speak upon some subject which should stimulate the underclassmen to higher scholarship. The organization holds monthly meetings at which papers are read by the active members of the chapter. Its affiliations were trans-

1. The formal coalition occurred at a joint meeting held in Chicago on March 12, 1916.

ferred to the College of Fine and Applied Arts in 1931 when the Department of Architecture became a member of that College.

Delta Mu Epsilon.-Delta Mu Epsilon, a local honorary fraternity in mining engineering, was founded in 1920 by members of the staff and students in the Department of Mining Engineering as a means of giving recognition to scholastic achivements of students of both graduate and undergraduate grade in this particular field. The first meeting was held in the spring of 1921. The programs of the organizations consisted generally of informal social gatherings and smokers, talks by members of the University staff or in some cases by outside speakers, and papers and discussions by the students themselves on some special topic of peculiar interest to the group. About 1928, the organization became dormant because of a decline in student enrollment and was never rejuvenated.

Chi Epsilon.--In the spring of 1922, two groups of civil-engineering students at the University of Illinois, one under the name of Chi Epsilon and the other, Chi Delta Chi,-each without the knowledge of the other,-took steps to petition the University administration for permission to establish an honor fraternity that would serve as a means of recognizing scholastic attainments among those enrolled in their department. As soon as the two groups became aware of the coincidence, they immediately set out to merge their interests; and on May 20, 1922, the Council of Administration of the University granted permission to found the organization under the name of Chi Epsilon Fraternity.

The objects of the organization as stated in its constitution are "to recognize those characteristics of the individual engineer deemed fundamental to the successful pursuit of an engineering career and to aid in the development of those characteristics in the undergraduate engineer."

It chooses its members from the upper ten per cent of the junior and senior classes. Still active in 1945, it holds a number of meetings throughout the academic year at some of which men inside and outside the College of Engineering speak of their professional problems. There were twenty chapters of the fraternity at the end of 1944.

[illegible]

Sigma Epsilon.-Sigma Epsilon, honorary Railway Engineering Fraternity, the first and only chapter of its kind in existence, was organized in the fall of 1923[1], and incorporated in February 1924. It was established to promote greater interest in railway matters, and limited its membership to junior and seniors and the faculty, in the Department of Railway Engineering. It always held its informal initiations in the locomotive laboratory,--on or around the locomotive on the testing plant. The organization became dormant a year or so before the Department was discontinued in 1940.

Phi Alpha Lamba.-Phi Alpha Lamba, honorary general-engineering fraternity, was established at Illinois in the spring of 1925, and was officially installed on May 19, 1925, at a banquet held in the Southern Tea Room. Membership was confined to juniors and seniors registered in the general-engineering curriculum, and was limited to those who had maintained an average scholarship within the upper third of their classes, and who had been more or less active in campus affairs. Each year, the organization sponsored a smoker for general-engineering students, at which prominent men of the College of Engineering spoke, the purpose being to enable the students to become acquainted with other men who were interested in the same general purposes and activities, and to learn more about some of the problems in their chosen profession. The fraternity became inactive sometime around 1935.

Phi Sigma Phi.-A new honorary, Beta of Phi Sigma Phi, undergraduate physics fraternity was installed in 1928-29, to take the place of an organization formerly called the Physics Club. The purpose of the organization was to honor students showing outstanding ability and leadership in physics. The programs consisted of talks by members of the departmental staff and in some cases by outside speakers, and of papers and discussions by the members themselves on some particular phase of physics work. On account of the limited enrollment in the curricula in engineering physics, the organization has had some difficulty in maintaining itself during the last few years.

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1. The Council of Administration of the University at its meeting on December 5, 1923, granted the petition to organize.

Alpha Sigma Mu.-Illinois Beta Chapter of Alpha Sigma Mu, national honor fraternity in metallurgical engineering, founded by the faculty of the Department of Metallurgical Engineering at the Michigan College of Mining and Technology in 1932, was installed at the University of Illinois at the close of the first semester of 1939-40, both graduate and undergraduate students in this particular field of engineering being eligible for membership. "Its purposes are to recognize scholastic attainments among students in metallurgical engineering, to aid in bringing the members more closely together, to help each other in every way possible, to be an effective link between the student and industrial metallurgical organizations, and to be of lasting benefit to its members not only while in college, but also after leaving college".[1] The chapter still active in 1945, holds a number of meetings throughout the academic year with programs relating to matters of social, business, and scientific interest.

D. PROFESSIONAL SOCIETIES AND FRATERNITIES

General.-Professional societies and fraternities include those self-directing, secret organizations that provide student associations for members having a common interest or purpose. Like the honor societies and fraternities, membership is by invitation, consideration being given to comradeship as well as scholastic standing, and generally goes to those who have at least average grades or better and who by the interest they show in organized activities, display considerable promise of leadership. The value of such organizations lies largely in the training which students derive from exchange of opinion and discussion, andfrom discipline that results from effective teamwork, from responsibility that must be assumed in directing the course of that group, and from incentives that stem from alliance with individuals having a mutual objective. A discussion of some of these organizations follows.

a. ALL-UNIVERSITY ORGANIZATIONS

Synton.-The society of Synton, founded on the campus here in 1925-26, was organized

1. It is of interest to note that Professor H. L. Walker, now Head of the Department of Mining and Metallurgical Engineering here, wrote the constitution of this fraternity when he was a member of the staff at Michigan College of Mining and Technology in 1932.

for the purpose of bringing together radio amateurs in order to promote the interests of radio among the students at the University. Only radio amateurs or men with an equivalent knowledge of radio are eligible for membership in the organization. There were twnety-one members in 1927-28. Honorary members include individuals on the faculty that are interested in this particular subject. The group installed on the campus for the use of its members a modern powerful radio station, designated 9 BCS. This station and its successor, W9ZOL, are described more fully in a later section of this chapter.

The organization has remained active throughout the years and is one of the most successful engineering societies on the campus. Its meetings include informal discussions of present-day amateur radio problems through papers, talks, and general discussions. It conducts a message service to all parts of the country and holds code classes each year for the benefit of those who wish to increase their speed so they can pass the Government examinations for radio-amateur licenses,-both services being free to those interested. The Society always plays a large part in staging the biennial Electrical Engineering Show.

b. ALL ENGINEERING ORGANIZATIONS

Triangle.-The Triangle Fraternity was founded at the University of Illinois on April 15, 1907, as a professional organization with membership limited to men registered in civil engineering. Within a fww years, students in architectural and ceramic engineering were also admitted. In 1921, the fraternity extended its membership basis to include all curricula of study leading to a degree in engineering,--basing its decision on the point that a breader association of men and interests would provide a stronger and better-balanced membership opinion and judgment. The group has always maintained its own chaptar house. Gradually the association took on the marks of a social organization, and in 1945 has the status of a social fraternity although still limiting its membership to engineers. Up to the end of 1944, seventeen other chapters had been established in schools located for the most part in the Middle West.

Theta Tau.-Kappa Chapter of Theta Tau, a national fraternity founded at the University of Minnesota in 1904, was installed here in 1916. It was a distinctly professional organization, choosing its members on the basis of personality and character and their show of promise of becoming successful engineers. Because a very large proportion of the members belonged to social fraternities, the organization had no chapter house of its own here,-a practice that was very different from that at most of the other schools,-but held its meetings at intervals of from two weeks to a month in the chapter houses of social fraternities. Theta Tau limited its membership to forty active men of sophomore, junior, and senior standing in the College of Engineering. There were ten faculty members in 1934. The students and faculty members represented practically every department in the College. For lack of interest, the organization became dormant about 1939.

Tau Pi.-Tau Pi, a professional engineering fraternity, was founded at Illinois in February, 1926, for the purpose of fostering the advancement of all branches of engineering and to promote a spirit of brotherhood within the profession. The organization selected its members from students in all departments of the College of Engineering. It became inactive, however, within a comparatively few years.

Sigma Phi Delta.-Delta of Sigma Phi Delta, professional engineering fraternity, founded at the University of Southern California in 1924, was installed on the campus here in January, 1928. The objects of the organization were "to promote the advancement of the engineering education; to instill a greater spirit of cooperation among engineering students and organizations; to inclucate in its members the highest ideals of Christian manhood, good citizenship, obedience to law, and brotherhood; and to encourage excellence in scholarship."[1] Membership here is open to students who are registered in engineering curricula in the University and who maintain an average scholastic record. The organization still in existence has had its own chapter house since its beginning.

c. DEPARTMENTAL ORGANIZATIONS

Scarab.- Karnak Temple of Scarab, a professional fraternity choosing its members from

1. Professional Fraternities, page 30.

architecture and landscape gardening or landscape architecture, was founded at the University of Illinois in 1909. Its objectives are "to provide a means of attaining a broader knowledge of Architecture and the Allied Arts; secure, through association, the advantages of a more refined culture; stimulate a greater interest in expression through the Graphic Arts; promote a friendly competition among the students and school of Architecture; and create a lasting spirit of fellowship and cooperation".[1] It has always been an active organization here, but transferred its affiliations to the College of Fine and Applied Arts when the Department of Architecture became a unit in that College in 1931.

Alpha Rho Chi.-Alpha Rho Chi was founded by the union of the Arcus Club at the University of Illinois and Sigma Upsilon local at the University of Michigan, on April 11, 1914, Anthemios Chapter having been installed here on May 21, following. The objectives of the fraternity are "to organize and unite in fellowship the architectural students in the universities and colleges of America, and to combine their efforts so as to promote the artisitic, scientific, and practical efficiency of the younger members of the profession".[2] The local group maintains a chapter house at the northeast corner of First Street and Armory Avenue in Champaign, drawing upon students in architecture, architectural engineering, and landscape architecture for membership. Its affiliations were transferred to the College of Fine and Applied Arts when the Department of Architecture was made a part of that College in 1931. In 1944, the organization had ten student and several alumni chapters located throughout the country.

Mu-San.-Mu-San, local professional fraternity in municipal and sanitary engineering, was originated here in 1916 when Municipal and Sanitary Engineering was a separate department, Professor Talbot having been largely responsible for the formation of the organization,-the only chapter of its kind in this field. The primary objective of the fraternity is to create a closerrelationship between students themselves and betweem students and faculty members interested in municipal and sanitary engineering. The association is still in existence, although now functioning under the Department

1. & 2. - Professional Fraternities, page 24.

of Civil Engineering, and has always had the most enthusiastic support of its membership.

Alpha Alpha Gamma.-A chapter of Alpha Alpha Gamma, a national organization for women enrolled in architecture, landscape gardening, and interior decoration, founded at Washington University, St. Louis, in 1922, was established at the University here during March, 1925. "The primary object of the organization is to promote good fellowship, friendship, enthusiasm, and cooperation among women studying architecture or any of its allied branches in colleges and universities of the United States".[1] The affiliations it had with the College of Engineering were transferred to the College of Fine and Applied Arts in 1931 when Architecture became a part of that College.

E. STUDENT ADMINISTRATIVE ORGANIZATIONS

The Association of Engineering Societies of the University of Illinois.-The Association of Engineering Societies of the University of Illinois was formed in 1894-95 by the three engineering student organizations then in existence,-The Civil Engineers' Club, The Mechanical and Electrical Society, and the Architects' Club,-for the purpose, in part at least, to publish The Technograph.. It had its headquarters in one of the rooms on the ground floor of Engineering Hall. The room was fitted up as a reading room and was provided with the leading technical journals. It was used also by those in charge of publishing the Technograph.

The Electrical Engineering Society, which had previously been merged with the Mechanical and Electrical Engineering Society and which became an independent organization in 1904, joined the Association in 1905-06. The Chemistry Club and the Mining Society affiliated with the Association during the year 1910-11. At the beginning of the school year 1911-12 the name of the organization was changed to Engineering Societies of the University of Illinois, which is described briefly in the next section.

Engineering Societies of the University of Illinois.-As previously stated, Engineering Societies of the University of Illinois came into existence during 1911-12 to supersede the Association of Engineering Societies of the University of Illinois. The Architects' Club dropped out at the beginning of 1912-13 and left the organization

1. Baird's Manual of American College Fraternities, 1935, page 575.

composed at that time of the Civil Engineers' Club, the Student Branch of the American Society of Mechanical Engineers, the Electrical Engineering Society, the Mining Society, and the Chemistry Club. Chemistry dropped out at the end of 1912-13 and the Railway Club came in then . The Ceramics Society joined the Engineering Societies at the beginning of 1915-16, and the Student Branch of the American Association of Engineers affiliated in December, 1920. The organization became somewhat inactive, and was later succeeded by the Engineering Council, the affairs of which are described briefly in the following section.

Engineering Council.-The Engineering Council was organized at the suggestion of Dean Richards during his administration early in 1919, for the purpose of setting up the machinery for coordinating certain engineering activities. At that time, the Council was comprised of one representative from each of the engineering societies on the campus. It assisted in directing the affairs of the Engineering Open Houses and in appointing committees to carry on the engineering dances. A representative of The Technograph was soon given a seat in the organization. With the founding of the College of Fine and Applied Arts and the withdrawal of the Department of Architecture from the College of Engineering in 1931, the architects and architectural engineers were eliminated from the Council.

In 1931-32, the Council was composed of the presidents of the student engineering societies including the American Society of Civil Engineers, American Institute of Electrical Engineers, the American Society of Mechanical Engineers, American Ceramic Society, Phi Alpha Lamba, Engineering Physics, Railway Club, Mining Society, and the editor of The Technograph.

As stated at that time by The Technograph,[1] the purpose of the Council was "to promote the general welfare of the student engineering societies and act on subjects of mutual interest, to manage social functions of the engineering student body, to establish a code of ethics among the engineering students, and to select men to represent the College of Engineering on the Illini Union Council and other organizations where the engineering student body is to be represented".

1 October 1931, page 31.

Within a few years, the Illinois Union had a representative on the Council. In 1938, then, the Engineering Council as a student board, was composed of the presidents of the eight departmental societies or clubs, a representative of the Illinois Union, and the editor and business manager of The Technograph. Its purpose as stated in the Technograph at that time was "to encourage the participation of engineering students in extra-curricular activities on the campus; and to sponsor such student engineering activities as the all-engineering smoker, St. Pats Ball, Illinois Student Engineering Exhibit (Engineering Open House/Show), and to assist in the production of the Electrical Engineering Show."

Like other associations, the Council has been active some years and rather inactive in others, depending upon the personnel and local conditions; but in the main, it continues to function when situations arise that call for attention.

Illini Engineers.-The organization of Illini Engineers was completed, on paper at least, in 1939 to replace the Engineering Council which at that time had become rather inactive. The purpose of the organization as stated in its constitution was "to unite the engineering students, faculty, and alumni of the University of Illinois and through this union to promote interest in the welfare and traditions of the College of Engineering." Membership in the organization was open to all students in the College of Engineering and the governing body was to be a Council. The organization functioned only part of a school year, then became inactive, and was never reactivated..

F. COOPERATIVE SUPPLY STORE

Engineering Cooperative Society.-The Engineering Cooperative Society, called the Real Co-op, organized in the spring of 1921, was sponsored by the united engineering societies for the purpose of operating a book and supply store near the engineering campus.. It obtained the use of a small store room immediately south of the Boneyard at 202 South Mathews Avenue. As the plan worked out, any student or faculty member could deposit $1, which enrolled him as a member of the Society. For every purchase that he made, he was given a receipt which he signed and deposited in a box in the store. These receipts were sorted periodically and each member was given credit on his record card for the amount he had purchased. Total purchases were computed

at the end of the school year and dividends paid, based on the total volume of business done and the net profit.

The policies of the store were determined by a Board of Directors consisting of two members from each of the campus engineering societies. A sophomore was elected from each society each year, and held office during his junior and senior years. There was a faculty advisory board consisting of three members of the faculty in the College of Engineering. All matters brought up before the Board of Directors was referred to the faculty board for approval.

After the first year of business, the selling space was more than doubled, and books and supplies for students in all departments of the University were added. A full-time manager was employed and several students assisted in serving the patrons.. The organization continued to expand, and in 1927[1] it stocked a new store at 610 East Daniels Street in Champaign. The Society failed, however, in 1934, and went into bankruptcy, after which the entire stock in the two stores was bought[2] by the Coop at thé corner of Wright and Green Streets, which has maintained the two establishments to date under the name of the University Book Stores.

G. ENGINEERING STUDENT PUBLICATIONS

The Illinois Technograph.[3] The Illinois Technograph, the technical magazine published by the students in the College of Engineering, was started in 1886-87 by the Civil Engineers' Club, which issed what afterwards became the first four volumes of the magazine under the title "Selected Papers of the Civil Engineers' Club." In the fall of 1890, the Club combined efforts with the Mechanical Engineers' Society to publish Volume 5 of the periodical, which by that time was called The Illinois Technograph.

The predominating feature of the Selected Papers and the early issues of The Technograph were technical discussions of an exceedingly high quality, many of the articles being republished in current engineering literature.. Volume 1 contained an article by W. D. Pence, '87, on "Hutton's Formula for Normal Wind

1. The formal opening was on January 3, 1927.
2. The exact date of transfer was May 28, 1934.
3. Most of the material in this section describing The Technograph was taken from the different numbers of that magazine itself.

Pressure". This paper described the classic experiments of Hutton from which much of the information about wind pressure was derived. Professor Baker's article "Hints to Students on the Education of an Engineer" was republished many times.

In the second volume was an article by Professor Talbot on "Waterways for Bridges and Culverts", which became a part of the standard engineering literature. The third volume contained two articles by Professor Baker which were subsequently included in his book entitled "Masonry Construction".. Volume 4 contained an article by J. B. Tscharner, C.E. '90, on the adhesion of drift belts, which was said to contain more information on the subject than all other records.

The Architects' Club, after it was formed in 1891, and the Mechanical Engineers' Society, after it became the Mechanical and Electrical Engineers' Society in 1891-92, joined with the Civil Engineers' Club during 1891-94 to publish Vols. 6 to 9 inclusive of the magazine. Volume 9 stated that the editorial board consisted of nine members, three of whom were selected from each of the three engineering societies. The 1894-95 number of the periodical was larger than usual, containing 182 pages as compared to the usual 100 of earlier years and the 146 of 1893-94. One of the reasons that partly accounted for this increase was that in 1892, the price was raised from 30 cents to 50 cents a copy, or 60 cents postpaid.

In 1894, a radical change was made in the method of handling the magazine.. The Association of Engineering Societies began to sponsor the periodical and provided an entirely independent staff, Under this plan, Peter Junkersfeld, '95, editor, supported by eight assistants, published Volume 9 in that year. The 1895-96 issue carried the following statement in regard to the editorial policies of the publication: "The technograph is a scientific publication issued annually by the Association of Engineering Societies of the College of Engineering of the University of Illinois. It is essentially technical in its scope and contains articles of permanent value in the various departments of scientific investigation carried on at the University or by its graduates."

For about ten years following this issue, The Technograph continued publication with but few changes in its make-up of from 140 to 160 pages. It included

some material of local interest about the affairs of the University, but the greater portion was comprised of technical articles of real value to practicing engineers and students alike. Volume 20 issued in 1905-06, contained an index of all articles that had been published in the magazine up to that date.

The policies of The Technograph in the early 1900's were expressed in the foreword to the 1907-08 issue as follows: "In publishing the Technograph, the attempt has always been made to rise somewhat above the general college periodical, into a sphere which may contain something of interest to the graduate and the practicing engineer."

The magazine had an intermittent career, however, during the years 1910-19,-- the first reverse in its history. The expense of publication was nominally borne by the advertisements and by sales, and of course the returns from these sources depended upon the activities of the students in charge; and if there were no money with which to pay bills, an appeal had to be made to the cooperating societies. Because of the indifference in response to those appeals and because of the discouragement over the financial conditions resulting from the 1909-10 issue, the paper was threatened with financial ruin and suspension.

One thing that had, no doubt, been partly responsible for the indifference was that there had been a feeling among the students, and the faculty that The Technograph in the preceding few years as an annual, did not measure up to its possibilities, and it was generally felt that some change was needed to make the organ of greater appeal. After some deliberations in which Dean Goss and the faculty and student representatives took part, the association was remodelled in 1910-11 with a new constitution and by-laws. The name of the organization sponsoring the magazine was changed from Association of Engineering Societies of the University of Illinois to Engineering Societies of the University of Illinois. As the Mining Society, recently organized, was included in the group, and as the Mechanical Engineers' Society had merged with the student Chapter of the American Society of Mechanical Engineers under the name of the latter organization, the Association was then composed of the Civil Engineers' Club, the Electrical Engineering Society, the

Student Chapter of the American Society of Mechanical Engineers, the Mining Society, and the Architects' Club.

Under the new order, two representatives from each group forming the Engineering Societies constituted The Technograph Board,-one sophomore being elected at the end of each year, who remained in office for two years. This arrangement assured continuity in office and a means for carrying out definite policies of management. The editor, business manager, and other officers of the staff were chosen from the Board. There was appointed an Advisory Board consisting of the Dean of the College of Engineering, two faculty members, and two alumni representatives. The magazine was made a quarterly,-the price of a single issue being fixed at $0.25 and the subscription rate at $1.00 a year.

It took two years, however, to effect a complete reorganization of the magazine from an annual to a quarterly basis during which time the Chemical Club also became a member of the group. During this transition, the scope of the publication was broadened in every department and was made to contain articles of more general interest. On account of the difficulties involved in making the change, there was only one number published in 1910-11, and that was issued in March, 1911, with 92 pages of material. In this number much more space was allotted to editorials and College and departmental notes, and some space was given to alumni news, a practice that has continued to date. There were three numbers issued in 1911-12, but Volume 27 issued in 1912-13, contained four complete numbers, all of them very creditable issues. No. 1 issued in December, contained 56 pages; No. 2, in February, 51 pages; No. 3, in March, 51 pages; and No. 4, in May, 66 pages.

For somd time after that, The Technograph came out consistently four times a year. The magazine was relatively small in size and content, and although the individual articles were in the main very good, the quality of the volume as a whole did not compare favorably with the issues from 1885 to 1901. In 1916-17 only one quarterly number was issued, and it contained only 58 pages. In 1917-18, notwithstanding the disturbance of World War I, four numbers were published. The war did, however, bring its problems, and the magazine had to suspend completely due to

lack of men and the high cost of materials. No issues were published in 1918-19 nor in 1919-20. The paper resumed publication, however, in the fall of 1920, but the magazine was completely reorganized. The size of the page was changed from a pocket size to letter-head size. The custom was established of having a different cut on each front cover. In March, 1923, the periodical became affiliated with the Engineering College Magazine Association, an organization sponsored to raise the standards of its member magazines by adoption of uniform standards of practice and by cooperation in both business and editorial problems. It was continued as a quarterly and the price was 40 cents a copy. Subscriptions to The Technograph were included in membership dues to the various professional engineering societies. The usual yearly volume contained about 200 pages, although the 1928-29 volume contained 250 pages.

In 1930-31, the magazine became a monthly publication appearing with seven issues,-October, November, December, February, March, April, and May. During 1931-32, there were eight issues. During that year, too, student articles were featured and more space was given to honor and professional organizations on the engineering campus. In 1933-34, the editorial policy was changed to reduce the number of technical articles and to describe more fully the activities of the students and to begin a Who's Who among the student leaders of the College. During that year, The Technograph became a quarterly again and continued as such until the end of 1936-37. During 1937-38 and 1938-39, there were six issues,- a page of each being devoted to a Who's Who among the faculty and the students. In 1939-40 the Who's Who page was replaced with "Names in the News". During that year, the publishers returned to the policy of issuing eight numbers and has continued to do to date.

For a number of years after 1894, the office of The Technograph was located in one of the rooms on the ground floor of Engineering Hall. Since 1920, at least, it has been in Room 213 on the second floor of that same building. The printing of the early numbers was distributed among a number of publishing firms, including The Gazette of Champaign, The Champaign County Printing Company, and the

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Bloomington Pantagraph Printing and Stationery Company. In 1920, however, the printing work was taken over by the Illini Publishing Company, and has been handled by that organization since that time.

The periodical, published practically continuously from 1887 to date,--sometimes aided by a small subsidy from the University, but generally by the sole efforts of the students,-has always been of distinct advantage in stimulating students to write and in giving its staff valuable editorial and business experience, for The Technograph has always followed the practice of printing only articles written by Illinois undergraduates, graduates, or members of the staff of the College of Engineering.

The Architectural Year Book.-The Architectural Year Book, first published in 1911, was an annual publication by the students in the Department of Architecture, intended to show the work of the school year. The best student work in design, construction, charcoal, and color was reproduced, and a brief record was made of the activities of the architectural students. The book consisted briefly of half-tone reproductions, and was a very creditable record of the work of the Department,--the students being responsible for the entire management and publication. No issue was printed in 1917-20 due to wartime conditions, but publication was resumed in the spring of 1921. When the Department of Architecture was transferred to the College of Fine and Applied Arts in 1931, the Year Book continued to be published by students in architecture, but under the auspices of the new College.

The Illinois Ceramist.- Beginning in 1936, the students in the Department of Ceramic Engineering, began to publish an annual yearbook called The Illinois Ceramist. The publication appeared late in the school year and contained photographs of students graduating in February and June with appropriate personalia accompanying each photograph. The fourth annual issue appearing in May, 1939, contained 32 pages. In 1940, the format was altered to an eight-page news sheet 10 1/2 by 14 inches, with items relating to the Student Branch of the American Ceramic Society and the Department and with photographs of all seniors.

Illinois Engineers' Day.-In order to promote the spirit of fellowship among the students and faculty members of the various departments within the College of Engineering, and in order to emphasize signal events of engineering interest, there was inaugurated a system of Illinoi Engineers' Day exercises. One event common to most of the programs marking these occasions, was a convocation where notable speakers were invited to address the assembly of students and faculty members. Some of these exercises are described briefly in the following paragraphs.

An all-engineering convocation of students and faculty was held in the University Auditorium on the afternoon of March 23, 1920, to commemorate the centennial of the birth of James Watt. Professor Breckenridge, formerly of this College, but at that time of Yale University, made the principal address on the subject: "James Watt, his Life and its Influence upon the Industrial Development of the World". Later in the afternoon and evening, the students staged their first engineering open house by exhibiting to the public the engineering laboratories under full operation.

That event turned out to be the first of a number of all-engineering day exercises held tomark some outstanding event. of local interest or to commemorate the achievements of some noted engineer.

Another Engineers' Day was scheduled when the Lecture Committee of the College decided upon an Engineering Convocation to be held on March 15, 1922. Since the close of that academic year marked a half century of service by Dr. Ricker to the University, it was decided to honor him at those exercises. When the plan was submitted to President Kinley for his approval, he suggested that the affair be made a University Convocation under the auspices of the College of Engineering in honor of Doctor Ricker.

The program opened when students and faculty met at 2:55 p.m. around Engineering Hall, and headed by a band of about sixty pieces, composed largely of engineering students, marched to the University auditorium, on the south campus, the procession extending from the Auditorium back to University Hall. The program was in charge of Dean C. R. Richards of the College of Engineering, who spoke briefly of the work Professor Ricker had done at the University. On the topic

"Serving the People", President Kinley spoke of the service which Professor Ricker had rendered this community and the State at large. The Alpha Rho Chi Fraternity then presented to the University a bust of Professor Ricker, and with appropriate words President Kinley accepted the gift for the University. President Ira N. Hollis of Worcester Polytechnic Institute delivered the main address of the Convocation on the subject of "The Engineer of 1950". Probably 2 000 persons attended the meeting,-the whole affair being a splendid tribute to a man who had devoted his entire life work to the University of Illinois and who had contributed so much toward its development.

On March 7, 1923 the all engineering convocation consisted of the induction of Dean Ketchum into the office of the Dean of the College of Engineering and Director of the Engineering Experiment Station. On that occasion, the engineering students and the faculty assembled in front of Engineering Hall and marched to the University Auditorium being led by a band composed of engineers. President Kinley presided at the meeting. The principal speaker was E. J. Mehren, '06, Editor of the Engineering News-Record and Vice-president of McGraw-Hill Publishing Company.. The subject of Mr. Mehren's address was "The Importance of Research to the Progress of Industry'. Dean Ketchum made a response with an address "Engineering Education and Research".

On Friday, April 4, 1924,[1] the engineers were given a holiday after 2:50 p.m. to participate in the celebration of the bicentennial of John Smeaton. The exercises began when the students and faculty assembled in front of Engineering Hall in preparation for a parade to the Auditorium. An engineers' band of fifty pieces led the procession followed by a military escort composed of regular army officers and the Engineers' Unit of the R.O.T.C. and a detail of student officers. Dean M. S. Ketchum and Professor Ira O. Baker were next in line. Immediately behind them were over 1 000 engineering students and faculty members who marched in file behind the floats of their respective departments.

The architects were first in line with their float representing a reproduction of the Acropolis. Next came a 20-foot spandrel concrete arch bridge con-

1. The Technograph, Volume 36, No. 4., May, 1924, Page 183.

structructed by the civil engineers. Following them came the model steam power station of the mechanical engineers. The general engineers came next with an exact replica of the famous Eddystone light house. The electrical engineers float which followed showed the three phases of their profession: power, illumination, and communication, featuring a radio setup that received music broadcasted from the Elecrical Engineering Laboratory. The mining float which came next,-the winner in the float contest,-depicted the three phases of mining: coal, metal, and metallurgy.. The railway engineers followed them and displayed a locomotive dominating the globe on which it rode. The ceramic float completed the parade with a large pottery kiln and a display of clay products. The procession passed through the University business district and campus and ended at the Auditorium where it disbanded for the convocation.

Dean Ketchum presided at the meeting and presented Dr. Baker, Professor of Civil Engineering, Emeritus, who gave the address of the day on the subject "The Future Status of the Engineer." At 6:00 in the evening, the faculty, and their wives got together for a dinner in the Urbana-Lincoln Hotel, and at 9:00 in the evening, about 300 hundred students assembled in the Gymnasium Annex for their annual engineering dance.

March 27, 1925, was also observed as Engineers' Day. Students and faculty members of the College assembled in the University Auditorium at 3 p.m., and E. J. Mehren, '06, addressed the convocation again that year. One feature of the occasion was the presentation to the University by W. L. Abbott '84, Chairman of the Portrait Committee, of the portrait of Professor A. N. Talbot. The gift was accepted by President Kinley, who presided at the meeting, in behalf of the University.. The students put on their usual all-engineering dance in the evening.

I. ENGINEERING STUDENT EXHIBITIONS

General.-Within reasonable limits, engineering students are encouraged to participate in student activities for maintaining an appropriate college spirit and for developing a side of their professional training that cannot be reached so readily by the

classroom and laboratory exercises. Among the outstanding features that are purely engineering in character are the departmental and all-College exhibitions and open houses. Some of these demonstrations are described briefly in the following sections.

Physics Open House.- Students and members of the staff of the Department of Physics began the annual custom in about 1906 of showing and demonstrating the departmental equipment to visitors, and thereby established the practice of giving an engineering open house. The exhibits, staged in the laboratories of Engineering Hall, where Physics was then located, consisted of displays of apparatus in the fields of light, sound, wireless telegraphy and other electrical operations, which were accompanied by lectures that described to the guests the principles and mechanisms involved.

Mehhanical Engineering Open House.-The members of the Student Branch of the American Society of Mechanical Engineers were hosts at the first Annual Mechanical Engineering Open House on Friday evening, October 23, 1914. During the evening about 2 000 guests from all departments of the University reviewed displays of student work, listened to lectures on topics of popular mechanics, and attended numerous demonstrations of machines in operation.

The second Mechanical Engineering Open House was held on Friday evening, October 15, 1915. Descriptions of the event state that during the evening probably from four to five thousand visitors passed through the various laboratories and shops of the Department of Mechanical Engineering, all of which were in operation. As in the first open house, souvenirs of ash trays, paper weights, and other small mementos, were distributed to the guests. One feature of the event was a moving picture show staged in the Old Armory that presented a number of industrial films of interest to engineering groups.

Because of changes being made in the Mechanical Engineering Laboratory building in 1916, there was no attempt to schedule an open house that year. The third Annual Mechanical Engineering Open House, however, was held on Friday evening, October 27, 1917, and the fourth one on April 26, 1919. These two, like the others were sponsored by the Student Branch of the A.S.M.E. There were no open-house events scheduled by the Department after that time, for the students in mechanical

engineering joined with those of other departments in the College of Engineering to present an all-engineering exhibition, described in a later section.

Electrical Engineering Show.-In the spring of 1907 during a nation-wide campaign in which the students of the Department of Electrical Engineering were invited to contribute their shrare towards a memorial to be erected in New York City to Robert Fulton, the first steam-boat builder, the group decided on a plan of presenting a modest electrical exhibit, for which a small admission fee would be charged to visitors. This exhibition, held on March 1-2, 1907, required only a week's preparation at practically no expense, and netted such a sum contributed by the 1 600 visitors that the organization was able to forward $250 towards the memorial fund. Similar shows, each a little more elaborate than the preceeding ones, followed. The proceeds of the next one held on April 26-28, 1908, were used to provide such furnishings as chairs, a table, and a rug for the Electrical Engineering Society reading room in the Electrical Engineering Laboratory, making it a more comfortable place in which to read and study. The popularity of these shows held in 1910 and 1913 was such that the available space in the Electrical Engineering Laboratory was taxed to the limit to handle the crowds,-the attendance in 1913 being about 3,600.

As early as 1915, it was decided to make commercial exhibits by outside companies a distinct feature of the Show, although it would require much additional space for the equipment. Accordingly, to accommodate the crowds and the added facilities for the 1915 Show, it was agreed to extend the period to three days, holding it on April 8-10, and to utilize the Old Armory (now the Gymnasium Annex) in addition to the Electrical Engineering Laboratory, for the military equipment had been transferred to the new Armory recently completed on the south campus. The 1917, 1920, and 1922 Shows followed the same plan. Although the lists of exhibits during those years had reached such a scale that the expenses ran rather high,--the 1922 Show requiring 450 student workers and demonstrators at an expense of $4 000,-there was some net income. This along with the income from the Shows held after 1908 was used to aid The Technograph and other University interests.

By 1924, the Show had gained such a national recognition that many large

electrical manufacturing and utility companies were anxious to exhibit their products during the event. While some of the exhibits were merely displays of electrical apparatus, others were among the most interesting stunts of the show. These included an automatic dial telephone system, an electric telegraph clock system, a miniature power transmission line, a model hydro-electric plant, and many other entertaining and educational features having a commercial flavor.

The income from these later shows was applied towards the accumulation of a loan fund to be administered by the University for needy and worthy juniors and seniors in electrical engineering. After the 1924 and 1926 exhibitions, the amount provided in the fund reached a total of $2 600; the admission fee at that time being 50 cents. Beginning in 1928, the Electrical Engineering Show and the Engineering Open House, described in the next section, were held in alternate years in order to maintain the interest of the public and not to throw an undue burden onto the students in any one year.

With the rapid development of the radio and the vacuum-tube field, including television and the photoelectric cell, and other recent discoveries in electrical engineering, the shows of 1928 and 1930 were able to present many unusual and spectacular demonstrations. These included radio broadcasting and receiving, power amplification, television, and talking pictures,-the last two being outstanding features of the 1930 exhibition. Part of the apparatus used in the television displays in presenting the latest developments in radio communication and transmission of images and loaned by aChicago television manufacturing company, had been exhibited before large crowds at shows in New York and Chicago. Still other features of the 1930 Show involved several unique stunts employing the photo-electric cell invented by Dr. Jacob Kunz of the Department of Physics of the University.

The profits from the shows after the 1930 exhibition raised the student loan fund to about $3 000 with another $ 1 000 in reserve to finance the next show. In 1932, the Physics Building was substituted for the old Armory or Gymnasium Annex, as a place to house the exhibits. The show in 1934 was staged in the Electrical Engineering Annex as well as in the Electrical Engineering Laboratory and Physics

Building,-an arrangement that has been continued to date. The Century of Progress cooperated during that exhibition by sending several highly attractive features and several members of its own staff to demonstrate and explain them.

Because for several years the Electrical Engineering Shows had attracted many groups of students and teachers from Illinois high schools, who came by school busses, chartered busses, trucks, and private cars over the highways, the Illinois Central and Big Four railroads arranged to give reduced rates to persons attending the 1936 Show. The high-school visitors came, for the most part, on the second day, Friday, April 17, and arrangements were made for special guides for the groups as they arrived. These guides conducted the visitors on a tour of the campus, and after the tour, they took them through the Show. Most of the high-school groups returned to their homes following the close of the afternoon session of the Show. In a few instances, however, the groups were sufficiently interested to remain for the evening session before returning. The admission price was lowered from the 50 cents previously charged to 35 cents, and a little over 4 200 attended, of whom about 1 600 used the special tickets coming from high schools.

At the Show held in April, 1938, the attendance reached about 5 700, and at the one in March, 1940, the seventeenth exhibition, the attendance was about 4 800. Because the student loan fund had accumulated to something over $6 000 in 1940, the students in charge voted to donate the Department of Electrical Engineering the sum of $120 for the purchase of small pieces of equipment needed in the electronics, radio, communication, and meter and relay laboratories. The last show to date was held on April 9-11, 1942.

During the recent years, the tendency has been to use more of the University's equipment and not so much from commercial exhibitors. Some of the apparatus is made for the purpose by students to display some feature of frivoloty such as the kiss-o-meter, the floating dishpan, and the electric chair. Most of the exhibits, however, have a serious purpose and seek to point out the latest advances in electrical engineering and are very instructive to those who give them thoughtful consideration. Each exhibit is in charge of a student or group of students who

demonstrates and explains the purposes of the experiment or discusses the historic development of the apparatus.

One of the chief advantages of the Electrical Engineering Show aside from establishing the Electrical Engineering Loan Fund for students and from demonstrating to the public the many uses of electricity, is that it has a unique and distinctive educational value to the students who organize and conduct the Show. The Show is an undertaking which calls for a consideration of practically all of the factors involved in any industrial or engineering project. The organization demands a careful consideration of the set-up of officers who should have charge of the enterprise. The selection of the student officers requires a careful consideration of the kinds of ability which should be possessed by the one holding each office as well as an analysis of the abilities of the various students in the department who are eligible for the various places. The undertaking necessitates that some consideration be given to business and finance matters and to the problems of setting up machinery for carrying on the project. Some consideration must be given to the Show itself and to the selection of exhibits which will be most worth while and which can be staged without undue time and expense. Some attention must also be given to a careful consideration of advertising and publicity. All of these things are aside from the problems which arise as the exhibits are worked out and perfected. There have been many evidences that individual students have been stimulated, encouraged, and helped by the work they do in connection with the Show. For example, certain students who do not have the superior qualities which lead to high scholastic records find that they possess other abilities which account for much in the practical affairs of life. Others soon discover that they have unusual qualities for leadership. Above all, the students have an opportunity to get valuable experience in doing things together. Something like 150 to 200 individuals take an active part in one way or another to make each show a success.

Engineering Open House or Illinois Student Engineering Exhibit.--The first regular all-engineering open house was held on March 23, 1920, to commemorate the cen-

tennary of the birth of James Watt, as previously mentioned. Early in the afternoon, Dr. L. P. Breckenridge, from 1893 to 1909, Professor of Mechanical Engineering at the University of Illinois, and after 1909, Professor of Mechanical Engineering at Yale University, gave an address in the University Auditorium on the subject "James Watt, his Life and its Influence upon the Industrial Development of the World". Later in the afternoon and during the evening, the public was given the opportunity to inspect the exhibits and demonstrations in the laboratories, drafting rooms, and shops. A 20-page pamphlet was issued which described briefly the sixty exhibits, part of which were active and part, static. The pamphlet also contained a map of the engineering group of buildings with a marked line to show the best order of making the tour.

Still other open houses, or as they were later designated Illinois Student Engineering Exhibitions, followed through the years with students in all departments taking part, working under the direction of the Engineering Council or other similar authority and a committee of the engineering faculty. The sessions usually ran from about 3:00 or 4:00 o'clock on Saturday afternoon to 11:00 in the evening. The particular dates chosen for these exhibitions were December 3, 1921; December 8, 1923; December 5, 1925; December 3, 1927; March 14, 1931; April 13, 1935; April 17, 1937; May 6, 1939; and April 4 and 5, 1941. During the later years, invitations were sent to the high schools of the State, to boy-scout groups, and to other persons from other state and nearby colleges.

The Engineering Open House has never been a stunt show, although many of its exhibits have been quite spectacular. Its purpose is primarily educational, and the exhibits have been displayed with the avowed aim of acquainting the students and faculty of the College of Engineering and of other colleges on the campus as well as the public in general, with the facilities and work of the College as a whole. The demonstrations do not depart from the routine that may normally be observed in the conduct of the activities of College during the school year. They are intended to show in such a manner as the public can readily observe, some of the fundamental principles that underlie the science of engineering. In only a few

cases has outside help been solicited in the preparation of exhibits, and then only when certain commercial exhibits could demonstrate more fully the operation of basic laws. No admission charge has ever been made to finance the exhibitions.

J. STUDENT AMATEUR RADIO STATIONS

Radio Station 9 BCS.[1] In the spring of 1924, a 5-watt radio set operating on a 40-meter wave length, was put together and operated in the Old Armory Annex. The range was short, partly due to the fact that a wave length of 200 meters was in general use. There was no organization of the station at that time and no organized radio club, the operation being carried on by radio amateurs attending the University.

Synton, the professional radio fraternity, previously mentioned, was organized that fall, and the group took over the station. Power was increased to 10 watts; and during the remainder of the 1925 season and the first semester of 1926-27, good communication was obtained with stations all over the world. During the second semester of 1926-27, power was increased to 50 watts, using a tuned-plate, tuned-grid circuit on short waves. With this equipment, the range increased very markedly. During 1927-28, the station was moved from the Armory Annex into the northwest tower of the Armory on Wright Street.

Early in the beginning of 1929, the U.S. Army obtained an appropriation to be used in installing 250-watt crystal-controlled short-wave sets wherever there was a Signal Corps unit of the R. O. T. C. This allowance did not cover the entire expense of such an elaborate set as Illinois had, and Synton financed the remainder at Illinois. The new station was used as one of the base control stations in the Army amateur net.. Eventually, all of the R. O. T. C. Signal Corps units will have such stations, and an intercollegiate news service can be carried on over the radio network. This work offered excellent practical training for signal-corps cadet operations, under approximately the same routine as is used in peace-time Army work.

Radio Station W9ZOL.-During the summer of 1937, members of Synton completed a new 500-watt transmitter, designated Radio Station W9ZOL. It was licensed to the student organization Synton through Professor Hugh A. Brown, who until his death in February, 1945, acted as trustee and held the license. The room in which it is located, 236

1. "From Radio Station 9BCS," by W. F. Ridgeway, E.E. '31, The Technograph, March, 1929, Page 133.

Armory Building, is furnished as a club room.

The receiving equipment usually consists of three receivers covering the broadcast, short-wave, and ultra short-wave bands. There are two main transmitters, one used for phone communication over distances up to 200 miles and the other for code work with stations all over the world. The power is 300 watts. Besides this, the Station is equipped with an oscillator for code practice and with small receivers and transmitters for experimentation.

In 1938-39 the new Synton 160-meter transmitter went on the air again, and a new six-tube communication receiver was installed in the station.

K. ENGINEERING STUDENT HONORS

General.-Students in engineering are graduated with honors or high honors on the basis of exceptional scholastic achievement in certain specified courses, totaling about forty semester hours in the junior and senior years of each curriculum, and of superior accomplishment in all other work of the curriculum. University recognition of high scholastic attainment is given special emphasis, also, by the Honors Day Convocation[1] in which engineering students of all classes are included in numbers proportional to their registration in the University. In addition, engineering students are honored by election to all-University honor organizations as well as to College and departmental societies.. Furthermore, engineering students are eligible to compete for University scholarship and fellowship awards.

L. ENGINEERING PRIZES AND AWARDS LIMITED TO THE UNIVERSITY
a. ALL-ENGINEERING

General.-Prizes and awards serve the useful purpose of stimulating the students to put forth greater effort in the performance of their classroom and extracurricular activities. In addition to the University prizes open to engineering students, there

1. Honors Day, first established on May 15, 1925, now one of the traditional events of the year, is marked by a special University convocation of students and faculty members to give, in a public way, specific and official recognition to students of outstanding records.. The occurrence, usually scheduled for May in each year and generally lasting about two hours, formerly began with a procession of the University Senate in academic costume and honor students, down Broadwalk from the old Library Building, now Altgeld Hall, to the Auditorium, where the exercises are held.. Of late years, the procession has been omitted to conserve time. The program includes an address by some distinguished speaker, followed by awards of prizes and the unveiling of the Bronze Tablet on which are listed the names of senior students in the Urbana departments of the University, whose grades are in the upper three per cent of their class in both junior and senior years. These tablets are later mounted permanently in one of the corridors of the General Library.

have been numerous prizes and awards made available through the generosity of individuals and engineering organizations, that have been restricted to students in the College of Engineering. Some of these prizes and awards are still in effect; others are no longer available to students in the College due to changes in policy and administration. Some discussion regarding the various prizes and awards follows in the next few paragraphs.

The Schaefer Essay Prize.--Mr. John V. Schaefer, alumnus of the University of the class of 1889, honorary M.E., '05, for a time Instructor in the College of Engineering, and later President of the Cement Gun Construction Company, offered a cash prize of $30 in 1921 for the best paper written by a student of Illinois under certain stipulated conditions, for Mr. Schaefer, himself an ardent member of the Philomathean Literary Society during his student days, saw very clearly the value in training which constructive writing would bring to the young engineer. The writer had to be beyond the freshman year and had to be enrolled in one of the curricula offered by the College of Engineering. The paper had to be written by the contestant himself describing in from 1 500 to 2 000 words some piece of engineering work or construction with which he had been personally connected in some capacity during a vacation period. The essay had to be accompanied by photographs and freehand sketches made by the writer.. The paper was to be judged by three men appointed by the Dean of the College of Engineering; and in making the award, consideration had to be given to diction, grammar, spelling, logical arrangement, completeness of description, excellence of photographs and sketches, and accuracy of detail..

The plan was changed somewhat in 1922, when two prizes were offered instead of one,-$25 for the best paper and $15 for the next best paper.. The offers were continued until 1931, but were withdrawn thereafter because of lack of interest among the students in such an undertaking.

Sigma Tau Prize.-For a number of years, Sigma Tau honor engineering society has offered annually the Sigma Tau scholarship medal to the sophomore student who made the highest grades of his class during his first year of work at the University.

The Technograph Prizes.-In 1920-21, The Technograph began the custom of offering each year a Mark's Engineers Handbook as a prize for the best article written by an under-

graduate engineering student describing some phase of a summer's work with which he had been connected. The essays were limited to between 1 500 and 2 500 words. In 1922-23, the prize was limited to freshmen only. The nature of the award was changed in 1928-29, when a bronze key was presented to the author of the student article, published in each issue, which was the most deserving of honor,--the articles being judged by the editorial staff of The Technograph.

b. DEPARTMENTAL

1. Architecture

General.-From the opening of the University until 1931, when the Department of Architecture withdrew from the College of Engineering to join the College of Fine and Applied Art, any arrangements made regarding prizes for students in that Department were subject to the general supervision of the College of Engineering. The list of prizes offered to students in that Department during that period are therefore described along with the others that are now or have been available to students in other departments of the College of Engineering.

The Plym Fellowship in Architecture.-A traveling fellowship carrying a stipend of $1 000 a year for advanced study in Architecture was made available in 1910-11 to the Board of Trustees of the University by Mr. Francis John Plym of Niles, Michigan, --graduate of the Department of Architecture with the class of 1897. During his school days, Mr. Plym was a member of the Adelphic Literary Society, and during his senior year, he was manager of the Illini. In 1906, he organized in Kansas City, the Kewaneer Manufacturing Company, making a specialty of various building fixtures which were widely used. Later, however, he transferred his operations to Niles, Michigan.

The following letter by Mr. Plym to the Trustees, expressed his desire in this matter of fellowships:

"In consideration of the great advantage which I received from the University of Illinois as a student, in testimony of my appreciation of this service, and because of my desire to do what I may in order to make the work of the institution more effective, I beg leave to offer to the University of Illinois the sum of one thousand dollars per annum in order to establish a fellowship for the advanced study of Architecture, which fellowship shall be assigned under rules and regulations which may be developed by the Board of Trustees of the University of Illinois".

The holder of the fellowship, which was awarded annually by competition in architectural design, was required to spend a year in study abroad, the money being available for defraying expenses incurred thereby. The first competition was held in 1911-12, and one was held annually ~~after~~ that except for the years 1918-19 and 1919-20 during World War I. So far as it is known, this is the first regular Scholarship award to be presented within the College of Engineering.

Mr. Plym continued to maintain the fellowship on a short-term basis until 1923, when he presented to the Board of Trustees as endowments certain holdings of stocks that became known as the Plym Endowment Fund, the income of which was to be used for financing the Plym Fellowship, which at that time was increased to $1 200 a year, and for establishing a foreign traveling scholarship for architectural engineering students, and for maintaining special local prizes described in later paragraphs.

The Plym Foreign Scholarship in Architectural Engineering.-The Plym Foreign Scholarship for Architectural Engineers, established in 1923 as mentioned in the preceding paragraph, was first offered in 1924-25. It carried a stipend of $700 a year and specified that the holder should spend six months abroad in the study of engineering and architecture.[1]

The Northwestern Terra Cotta Company Prize.--During the year 1912-13, the Northwestern Terra Cotta Company offered a prize of $50 for the best design for a building for execution in terra cotta. A problem was given to the more advanced juniors of the Department, and so many of the designs submitted had points of excellence, that the prize was divided among five of the contestants.

The Llewellyn Prize.-Beginning in the fall of 1913, Mr. J. C. Llewellyn, Illinois '77, offered a prize of $50 a year to be given four consecutive years for the purpose of stimulating the study of design by the students in architectural engineering. At the end of that period he did not renew his offer because of existing uncertainties due to the war and conditions in industry.

1. In 1937-38, the plan was changed very materially, when the award became known as the Plym Fellowship in Architectural Engineering. The stipend was increased to $1 200. It is offered annually, and the winner of the prize must use the money for a year's travel and study abroad.

The Ricker Prize in Architectural History.-The Ricker Prize in the History of Architecture, founded by the Alpha Rho Chi Fraternity in 1922 and first offered in 1921-22 or 1922-23, was established in commemorative honor of the long, faithful, and distinguished services of Dr. Nathan Clifford Ricker to the Department, to the University, and to the architectural profession, especially along the lines of architectural history, for he had taught architectural history in the University for fifty years. The prizes were awarded for the best three essays or drawings which were presented upon a subject prescribed by the Professor of History of Architecture. At first, the prizes consisted of $50 ~~dollars~~ worth of architectural history books given annually to three competitors,-the highest receiving $25, the second $15, and the third $10. Later, the awards were made in three gold keys.

The Van Dort Prizes.-On account of his interest in the Department of Architecture in general and in Professor Ricker and his work in particular, Mr. G. Broes Van Dort of Chicago, offered in November, 1922, $25 worth of books to be awarded as prizes by the Department of Architecture in connection with some problem in design. Since the details were left to the staff here, it was decided that this money should be divided into two prizes,--one of $15 and the other of $10,-and that theprizes should be allocated to the senior work in architectural design. Mr. Van Dort repeated his offer in 1923 and 1924. He also gave similar amounts during the years 1929-30 and 1930-31, not only for the solution of problems in senior design, but also for those in junior architectural design.

The Plym Prizes for Architectural Engineers.-For some time, the Department of Architecture offered as prizes $50 of the interest which accumulated from the $4 000 invested by The University from the four Plym Fellowships which were not used during World War I because the winners were not able to go abroad to study. After 1923-24, the prizes were changed somewhat, for a part of the proceeds from the endowment by Mr. Plym was used for prizes for architectural engineers. Seventy-five dollars were used annually for the purchase of books as awards to those three seniors in Architectural Engineering who presented the most orderly and best solution to the problems which were presented. In making the decision, the work of the

entire second semester was considered; and the accuracy, arrangement, neatness, sketches, and draftsmanship were factors upon which the awards were based.

The Plym Prize for Summer Sketches.-In order to stimulate interest in summer sketching, a prize of $15 from the interest on the Plym Endowment Fund was used for the purchase of books to be awarded to that student who presented the most interesting and best outdoor sketch or best collection of outdoor sketches made during the summer vacation.

The Plym Prize for Sketch Problems.-Ten dollars of the interest from the Plym Endowment Fund were used each year for books to be awarded as a prize for the best solution of any sketch problems submitted during the academic year. The purpose of the offer was to stimulate students in undertaking the voluntary sketch problems offered, as it was through the sketch problem that a student in a few hours could record his thoughts and present them in a logical manner. This prize was first offered in 1924-25.

The Allerton American Travelling Scholarships.-Mr. Robert Allerton offered the Department of Architecture in 1928-29, $800 to be used by two ranking junior students who were registered in History of Architecture, for travel through New England that summer to study early American architecture.

The Lake Forest Foundation for Architecture and Landscape Architecture.--The Lake Forest Foundation for Architecture and Landscape Architecture was established in 1927-28. Each spring, each of the departments of architecture and landscape architecture at Ohio, Iowa, Michigan, and Illinois, recommend two seniors for a three-months' summer course to be given at Lake Forest.

The Gross Prize.-In the fall of 1925, Mr. Christian Gross, Secretary, The American Embassy, Paris, gave the sum of $100 as a prize on a design for "A Villa" by students in architectural design.

American Institute of Architects School Medal.-Each year since 1914, the American Institute of Architects has presented a medal to the senior in Architecture who showed the greatest and most consistent development during his four-year course in the University. Scholarship in all phases of the work is considered in formulating the award.

Scarab Medals.-During the second semester of each year since 1914-15, the Scarab Competition has been conducted under the auspices of the Department of Architecture for a bronze medal to be awarded to that junior in architectural design who should present the best solution to an assigned problem. In 1926-27, the Scarab Fraternity began to offer a medal, also, to architectural engineers for proficiency in architectural design.

Gargoyle Certificate.-Beginning in 1926-27, Gargoyle Society established the custom of awarding a certificate of merit to that sophomore in architecture and architectural engineering who made the highest average grades during his freshman year. In addition to the certificate from the Society, he had his name placed on the honor roll hung in the Ricker Library.

2. CIVIL ENGINEERING

Ira O. Baker Prizes.-In 1923-24, the late Dr. Ira O. Baker, Professor of Civil Engineering, Emeritus, and for forty-eight years a professor in the department, endowed two prizes to be awarded annually to the two ranking senior students in civil engineering rated on the following basis:

Scholarship	70%
Authorship of technical articles	10
Activity in technical associations	10
General characteristics	10
	100

These prizes, amounting to $75 and $25 respectively, are presented primarily on excellence of scholarship and secondarily on personal qualifications and professional activity, as the above rating indicates. The names of the winners in each year are placed on a bronze tablet located near the office of the Department of Civil Engineering, and a special certificate is granted to each winner. Since 1934-35, the awards have been made at a special convocation of civil-engineering students, called during one of the morning class periods, as a means of giving public recognition for meritorious attainment.

Awards of the Central Illinois Section of the American Society of Civil Engineers.-Since 1931, the Central Illinois Section of the American Society of Civil

Engineers has offered annually, a year of junior membership to the American Society of Civil Engineers, a badge of the Society, and an engrossed certificate of award, to two graduating civil engineers and to one graduating non-civil engineer who have attained high scholarship averages and who have been active in promoting the affairs of the student chapter at the University.

Awards of the Illinois Section of the American Society of Civil Engineers.-The Illinois Section of the American Society of Civil Engineers makes eight awards each year of the initial fees for junior membership in the parent organization, to students in engineering schools located in the vicinity of Chicago*, two of these being graduating students at the University of Illinois. While they are not necessarily students registered in civil engineering, they must be members of the student chapter. The men selected, receive their awards at a special meeting called for the purpose in Chicago.

Awards of the Student Chapter of the American Society of civil Engineers.-In 1922-23 the Student Chapter of the American Society of Civil Engineers offered a Ketchums' Structural Engineers' Handbook to the civil engineering student writing the best article on summer work. The article had to be limited to between 1000 and 2000 words.

3. MECHANICAL ENGINEERING

American Society of Mechanical Engineers' Prizes.--On October 6, 1915, the American Society of Mechanical Engineers initiated a custom of offering a trophy cup as an award for the best original paper prepared and read before the Student Branch of the Society by a student member of that organization.

Central Illinois Section of the American Society of Mechanical Engineers' Prizes.- At the May 3rd, 1939, meeting of the Student Branch of the American Society of Mechanical Engineers, six mechanical engineering students read original essays from which three were selected to present their papers, in competition for awards, at a dinner meeting of the Central Illinois Section of theAmerican Society of Mechanical Engineers. The dinner meeting was held at the University Club on the evening of May 6, 1939, with 69 members in attendance. The three prizes were $15, $10, and $5. The results were so satisfactory that the practice of conducting such contests has

continued to date.

Pi Tau Sigma Prize.- Pi Tau Sigma, honorary mechanical engineering fraternity, usually presents each year a mechanical engineer's handbook to the mechanical-engineering freshman with the highest scholastic standing for the year.

4. ELECTRICAL ENGINEERING

Eta Kappa Nu Prize.-The Eta Kappa Nu honorary electrical engineering fraternity, re-established an old custom in 1922-23 by offering a Penders' Handbook to the sophomore student in electrical engineering who during his freshman year made the highest grades in all of his work. The prize was presented each fall at an open meeting of the fraternity given for freshmen and sophomores.

5. CERAMIC ENGINEERING

Keramos Prize.-Beginning in 1922-23, Keramos, honorary ceramic fraternity, decided to give a prize to the sophomore ceramic student having the highest scholastic average for the freshman year.. The prize consisted of a years' subscription to the Proceedings of the American Society of Ceramic Engineers and one year's subscription to the Transactions.

M. PRIZES AND AWARDS NOT LIMITED TO THE UNIVERSITY

American Society of Mechanical Engineers' Prize.-Since 1932, the American Society of Mechanical Engineers has sponsored an Annual Midwest Student Branch Conference that has been held in Chicago or some other midwest point, as previously mentioned, in which members of the student branches of the Society from midwest engineering schools compete in the presentation of original papers. The prize offered is an award of $50 for the most meritorious paper and $25 for the next best presented at the Conference. As many as seventeen schools have been represented at one time in these contests.

Highway Prize.-Since 1936-37, the Illinois Association of County Superintendents of Highways has given an annual prize of $25 for the best paper written by a senior in Civil Engineering on the highway field, such as design, construction, maintenance, and so on. This is given with the understanding that the winning paper will be presented at the Annual Highway Conference of Illinois.

John Smeaton Award.--Since 1936-37, The Illinois Concrete Pipe Association has given an annual prize of $25 for the best paper written by a senior on the manufacture of concrete pipe.

Tau Beta Pi Fellowship.--Six fellowships of approximately $650 each, for graduate study in any engineering college of recognized standing, are awarded annually by Tau Beta Pi, national engineering honor society, in competitions open to members of the organization in any American college or university where a chapter of Tau Beta Pi exists. The recipients are selected by a national board from candidates recommended by the local chapters.

American Institute of Mining and Metallurgical Engineers' Prize.--Since 1939, the American Institute of Mining and Metallurgical Engineers has sponsored a "Student Technical Paper Writing Contest". The papers written by Illinois students are presented at the Chicago and St. Louis Section meeting of the A.I.M.E. and then are forwarded to the National meeting in New York where they are judged in competition with those from other regions.

N. ENGINEERING STUDENT DEBATING CONTESTS

General.--A debating team of three men from the College of Engineering was organized about 1923-24 to debate with teams from some of the other colleges on the campus. The next year there was established here the Inter-college League for the purpose of stimulating intramural debating on the campus.. Teams taking part represented the Colleges of Engineering, Commerce, Law, Education, Agriculture, and Liberal Arts and Sciences.

As the plan operated in the College of Engineering, the candidates who survived the preliminary elimination try-outs,-and there were six of these for first competition under the new set-up,-were allowed two weeks to prepare for the College of Engineering finals. In this final try-out, two men were chosen from the six to represent the College of Engineering in the inter-college debates. Each of these men was awarded a prize of $25. Each member of the team winning the all-University debate received $50 and members of the losing team $25. In addition to these

prizes, a silver cup, on which the names of the debaters and their years were inscribed, was presented to the College whose team won the final debate.

These debates, in which the engineers usually won more than an even share of the contests, served to provide the opportunities for and advantages of keen forensic competition and to develop a stronger esprit de corps among members of the student body.

O. ENGINEERING STUDENT SOCIAL EVENTS

a.. ALL-COLLEGE AFFAIRS

Engineering Dances.-The custom of holding engineering student dances was instituted on April 15, 1910, when about 170 couples met in the Armory on Springfield Avenue to waltz to the rythmic tunes of old-time music. The second one was on April 21, 1911, the third of April 12, 1912, in which 175 couples took part, the fourth on April 4, 1913, the fifth on April 30, 1915, and the sixth on April 29, 1916,-all in the Armory on Springfield Avenue, or as it became known in 1916 as the Gymnasium Annex.. The practice was discontinued during the war and was not revived for a number of years,-the next on record being held on April 13, 1923. Others in series followed on April 4, 1924, March 27, 1925, March 26, 1926, and March 23, 1928,-all in the Gymnasium Annex. The outstanding advantages of such gatherings are to provide for wholesome student entertainment, to serve as a means of forming acquaintenships, and to promote and maintain a proper balance of college spirit.

St. Patrick's Ball.-Although the traditional St. Patrick's Day comes on March 17, the first all-engineers' dance that was designated as St. Patrick's Ball was held in the Urbana-Lincoln Hotel on the evening of April 17, 1934, under sponsorship of the Engineering Council. There were about 250 couples in attendance at this affair. Approximately 450 couples attended the second Ball held in the Gymnasium Annex on March 16, 1935. The third Ball was held in the Gymnasium Annex on March 27, 1936, and the fourth on March 12, 1937. The George Huff Gymnasium was the scene of the fifth, held on March 25, 1938, and the lower gymnasium of the Woman's Building, the sixth, on March 17, 1939, about 300 couples taking part. None has been held since that time.

All-Engineering Smokers.-All-engineering parties, generally smokers, have been held from time to time under the auspices of some central administrative group. One of these was held in the old Illinois Union Building on Wright Street on the evening of December 14, 1923. The principal attraction there was a boxing and fencing match. The first smoker sponsored by the Engineering Council, and the first event of its kind in ten years, was held in the Skating Rink on October 10, 1934. The Council sponsored another one in the Gymnasium Annex, on October 23, 1935, and still another one in Bradley Hall on October 21, 1936. About 600 attended the last one, which featured short talks by members of the faculty. The refreshments consisted of doughnuts, cider, and smokes. The chief advantages of such assemblies of all grades of students and faculty members from different departments lie in providing opportunities for closer acquaintanceship and for exchange of view-points by members of the different groups.

b. DEPARTMENTAL

Class Dinners and Smokers.-The first annual banquet of the senior class in civil engineering and municipal and sanitary engineering was held in the Beardsley Hotel on January 20, 1906. The professors and instructor having senior engineering classes in those curricula were guests. The mechanical-engineering seniors held their first annual banquet at the Beardsley Hotel on March 24, 1906. They held one on April 6, 1907, at the Columbia Hotel in Urbana. Similar events scheduled rather regularly by these and other corresponding groups during the following years, gave way to dinner meetings, smokers, and other informal gatherings staged by scientific societies, honor and professional fraternities in later years. All of these activities throughout the years served about the same purpose, however,-that of providing opportunities for some intellectual discussion and diversion and for better acquaintanceship between students themselves and between students and faculty members.

The Architectural Fete and Fine Arts Ball.--The Architectural Fete, the annual costume party sponsored by the students in the Department of Architecture, was held for the first time in the spring of 1917, and except in 1919 following World War I,

was repeated each year on the engineering campus until 1927,-the function being held in the Ricker Library of Architecture and in the corridors of the fourth floor of Engineering Hall. The costumes and decorations were always designed to represent the particular atmosphere of some period or country, such as Venetian, Persian, Egyptian, Pompeian, Greek, Spanish, Chinese, Russian, Futurist, etc. After a time students from the Departments of Landscape Gardening, Art and Design, and Music were invited to join in the annual event.

After the Department of Architecture moved into its new building for Architecture and Kindred Subjects, on the south campus at the beginning of the second semester of 1927-28, the Fete was held on the first floor in the exhibition room and hall of casts. The list of sponsoring organizations was expanded to include not only those previously mentioned, but also Pierrots, Mask and Bauble, and the Daubers, and the name of the institution was changed to "Fine Arts Ball". On April 4, 1930, the Ball was held in the Gymnasium Annex and was open to any one who cared to buy a ticket. The event ceased to be an engineering affair in 1931 when the Department of Architecture became a unit of the College of Fine and Applied Arts.

In addition to their recreational value, these programs served the useful purpose of accenting the peculiar characteristics of the special periods portrayed by the representative settings.

CHAPTER XXVI.

ENGINEERING ENROLLMENT, DEGREES, AND GRADUATES

A. ENROLLMENT

a. UNDERGRADUATE STUDENT ENROLLMENT

General.-Table XXVIII shows the enrollment of undergraduate students by years and by departments in the College of Engineering and the total registration of the University from the beginning to date.

In the early years of the University, the total enrollment in the College exceeded that of all other colleges combined, as for example, in 1891, there were 302 students in the College of Engineering and only 583 in the entire University. Even up to 1910-11, the engineering registration was more than half of the men students in the University, for the gradual industrialization of American industry through methods of large-scale production following the development of new principles and laws in engineering science, required the services of so many technical graduates that it caused an even greater interest in this special field resulting in an increase in enrollment that reached a peak of 1 274 students in that particular year. Then followed a ten-year period of approximately constant enrollment, ending with a registration of 918 in 1917-18 during World War I. From a post-war registration of 1768 students in 1919-20, the College moved gradually downward to an enrollment of 1 461 in 1923-24, then upward to a new high of 1 876 in 1930-31. During the summer of 1931, the Department of Architecture was transferred to the newly-organized College of Fine and Applied Arts, thereby reducing the registration of the College of Engineering about 450 students. However, the progressive expansion in the field of both public and private enterprise made even greater demands for technical graduates to serve in the development of natural resources and materials of production, in the erection of buildings and other structural types, in the construction and operation of hydraulic and central-station power plants, and in the manufacture of automobiles and airplanes and other instruments of transportation. The enrollment responding to this demand gradually increased again, reaching an all-time high of 2 173 in 1942-43.

Throughout the years, the curriculum which attained the highest enrollment

is the oldest one, Mechanical Engineering,-which in 1942-43 had a peak of 811. The least popular was that of Gas Engineering, which had a brief existence from 1925 to 1929, with less than a half dozen students. The highest figure in Civil Engineering was 421 in 1909-10; in Architecture, 260, in 1929-30; in Architectural Engineering, 235 in 1929-30; in Mining Engineering, 89, in1921-22; in Metallurgical Engineering, 126, in 1941-42; in Electrical Engineering, 471, in 1925-26; in Municipal and Sanitary Engineering, 36, in 1914-15; in Railway Engineering, 60, in 1922-23; in Ceramic Engineering, 178, in 1937-38; in Ceramics, 74, in 1935-36; in Engineering Physics, 67, in 1942-43; in General Engineering, 396, in 1942-43; and in Agricultural Engineering, 40, in 1941-42.

TABLE XXVIII–REGISTRATION OF UNDERGRADUATE STUDENTS BY YEARS AND DEPARTMENTS IN THE COLLEGE OF ENGINEERING AND TOTAL REGISTRATION IN THE UNIVERSITY
1867 to 1945

Year[1]	Mechanical Eng.	Civil Eng.	Architecture	Arch. Eng.	Mining Eng.	Met. Eng.	Electrical Eng.	Mun.&San.Eng.	Ry. Civ. Eng.	Ry. Elect. Eng.	Ry. Mech. Eng.	Ceramic Eng.	Ceramics	Eng. Physics	General Eng.	Gas. Eng.	Agric. Eng.	Aero. Eng.	Total Eng.	Total University*
1867–68																			20	77
68–69																			41	128
69–70	46	1																	47	180
70–71	39	24	4																67	278
71–72	32	46	4		2														84	381
72–73	24	49	4		2														79	400
73–74	22	49	6		3														80	406
74–75	33	33	15																81	373
75–76	22	31	15																68	386
76–77	24	25	9		2														60	388
77–78	20	18	7		2														47	377
78–79	28	21	4		6														59	416
79–80	25	24	9		3														61	434
80–81	25	30	6		3														64	379
81–82	41	41	14		3														99	352
82–83	39	52	18		3														112	382
83–84	45	51	21		2														119	330
84–85	56	58	26		1														141	362
85–86	53	43	24		3														123	332
86–87	65	45	28		4														142	343
87–88	57	53	46		4														160	377
88–89	74	62	59		6														201	418
89–90	78	71	61		6														216	469
90–91	78	95	73		5														252	519
91–92	88	87	92		6		29												302	583
92–93	53	75	75		6		58												267	714
93–94	48	73	81		2		84	5											293	718
94–95	66	73	73				91	2											305	810
95–96	60	59	69	17			97	3											305	855

1. Figures up to 1910–11 include the Preparatory Department or Academy.

Year[1]	Mech. Eng.	Civil Eng.	Architecture	Arch. Eng.	Mining Eng.	Met. Eng.	Elec. Eng.	Mun.&San.Eng.	Ry.Civil Eng.	Ry.Elec.Eng.	Ry.Mech.Eng.	Ceramic Eng.	Ceramics	Eng. Physics	Gen. Eng.	Gas. Eng.	Agric.Eng.	Aero. Eng.	Total Eng.	Total Univ.[1]
96-97	55	66	56	13			86	3											279	1 059
97-98	47	70	47	14			89	2											269	1 582
98-99	66	74	42	15			82	6											285	1 824
99-00	79	99	41	14			84	5											322	2 225
00-01	105	120	43	12			88	5											373	2 505
01-02	124	167	40	19			109	3		2									464	2 932
02-03	182	197	56	27			137	8		6									613	3 289
03-04	219	232	47	43			172	8		3									752	3 592
04-05	215	310	42	31			223	10		1									855	3 734
05-06	233	338	73	30			254	9		3									940	4 091
06-07	261	400	77	43			280	5		11									1 077	4 318
07-08	256	397	82	58			311	19		28									1 151	4 746
08-09	261	419	90	67			305	19		49									1 191	4 979
09-10	265	421	97	89			256	18		38									1 184	5 118
10-11	271	307	177	106	19		320	22	21	19	12								1 274	5 217
11-12	265	305	189	111	21		301	25	17	15	9								1 258	5 300
12-13	260	216	203	129	24		279	24	8	5	7								1 155	5 087
13-14	276	204	200	164	42		253	30	11	12	10								1 202	5 529
14-15	271	206	179	179	39		269	36	13	15	6								1 213	6 004
15-16	249	193	158	177	30		267	25	19	17	11	69							1 216	6 427
16-17	286	204	149	162	30		273	28	14	16	8	43							1 213	6 828
17-18	229	163	72	133	18		228	11	14	16	8	26							918	5 590
18-19	524	325	75	100	21		396	11	13	7	3	56		6					1 537	7 157
19-20	528	351	120	156	61		455	12	10	20	6	46		3					1 768	9 249
20-21	473	313	121	140	66		443	13	14	21	11	42		4					1 661	9 493
21-22	431	355	120	130	89		427	10	16	28	9	76		5	44				1 740	10 627
22-23	325	298	110	118	66		344	15	19	31	10	74		10	97				1 517	10 869
23-24	263	256	94	138	55		374	15	23	31	5	88		9	110				1 461	11 083
24-25	244	293	121	153	39		403	14	19	20	9	90		9	102	1			1 517	12 092
25-26	233	292	150	172	38		471	15	17	21	8	89		6	105	4			1 621	13 399
26-27	232	320	182	209	21		456		20	27	9	58	34	12	101	3			1 684	13 731
27-28	269	341	224	229	15		426		21	24	5	60	36	14	101	3			1 768	14 071
28-29	291	326	258	219	25		411		17	18	4	37	34	11	86				1 737	14 183
29-30	334	335	260	235	19		400		11	26	4	37	36	18	85				1 800	14 549
30-31	380	362	259	185	23		452		10	18	6	48	35	25	98	4			1 876	14 986

1. These records were taken from The Technograph, Vol. L, No. 1, Sept. 1935, Pg. 7.

Year	31-32	32-33	33-34	34-35	35-36	36-37	37-38	38-39	39-40	40-41	41-42	42-43	43-44	44-45
Mech. Eng.	373	298	260	279	343	482	616	678	670	758	775	811	255	170
Civil Eng.	373	293	261	262	268	294	299	308	326	308	325	314	134	96
Architecture														
Arch. Eng.														
Mining Eng.	17	19	15	27	28	27	26	24	23	22	18	19	8	11
Met. Eng.			4	11	23	49	80	118	125	121	126	95	43	17
Elect. Eng.	408	331	305	299	320	329	375	366	358	343	330	347	127	132
Mun. & San. Eng.														
Ry. Civil Eng.	11	5	4	2	2	2	10	8	6					
Ry. Elect. Eng.	19	15	11	9	9	7	8	5	7					
Ry. Mech. Eng.	5	3	3	3	4	7	8	11	12					
Ceramic Eng.	72	100	93	127	141	159	178	128	110	101	79	64	12	15
Ceramics	24	26	47	69	74	68	55	53	51	40	36	24	8	5
Eng. Physics	26	27	26	32	22	13	32	40	37	36	48	67	38	13
Gen. Eng.	95	97	103	83	113	137	145	183	214	217	231	396	137	189
Gas Eng.	2	1												
Agric. Eng.				12	10	16	21	28	44	39	40	36	6	12
Aero. Eng.														35
Total Eng.	1 425	1 215	1 132	1 215	1 357	1 590	1 853	1 950	1 983	1 985	1 988	2 173	768	696
Total University	14 569	12 875	12 122	13 067	14 036	15 831	16 865	17 500	17 212	17 392	15 995	15 972	13 639	12 571

The figures for enrollments by classes in engineering from 1904 to date are given in Table XXIX. All of the numbers in the total column do not check with those in the corresponding column in the previous table, probably due to differences in making records of enrollments and allowing for duplications and second-term registrations.

TABLE XXIX. - UNDERGRADUATE ENROLLMENT BY CLASSES IN ENGINEERING
1904 - 1945

Year	Freshmen	Sophomores	Juniors	Seniors	Unclass.	Total
1904-05	261	252	182	116	54	865
1905-06						
1906-07	387	266	175	182	83	1093
1907-08	450	313	199	156	56	1179
1908-09	358	359	276	177	45	1215
1909-10	399	319	296	235	39	1288
1910-11	377	353	255	239	27	1251
1911-12	375	335	283	224	13	1230
1912-13	357	289	292	212	13	1163
1913-14	365	302	247	255	9	1178
1914-15	377	297	272	228	4	1178
1915-16	337	295	302	255	3	1192
1916-17	337	301	279	252	7	1176
1917-18	307	215	204	155	10	891
1918-19	1137	230	133	84	1	1585
1919-20	752	470	265	200	27	1714
1920-21	638	430	342	191	6	1607
1921-22	627	377	371	293	6	1674
1922-23	541	345	323	330	12	1552
1923-24	496	324	310	280	3	1413
1924-25	598	338	308	269	2	1515
1925-26	575	441	272	266	3	1557
1926-27	660	412	353	241	3	1669
1927-28	592	458	341	307	7	1705
1928-29	600	432	347	310	12	1701
1929-30	649	440	335	346		1770
1930-31	645	498	363	322	5	1833

Year	Freshmen	Sophomores	Juniors	Seniors	Unclass.	Total
1931-32	435	397	314	274	5	1425
32-33	352	283	269	307	4	1215
33-34	372	250	244	263	3	1132
34-35	465	269	251	224	6	1215
35-36	554	280	280	243		1357
36-37	677	375	290	243	5	1590
37-38	758	457	376	259	3	1853
38-39	672	520	442	311	5	1950
39-40	647	495	454	384	3	1983
40-41	750	460	396	379		1985
41-42	772	525	377	314		1988
42-43	1121	387	391	274		2173
43-44	351	106	158	152	1	768
44-45	515	85	49	39	8	696

b. GRADUATE STUDENT ENROLLMENT

General.-Table XXX[1] shows the registration of graduate students in the various departments or curricula in engineering. The registration reached a peak of 185 in 1931-32,-about the worst of the depression years. It was only logical that as many young men were unable to find jobs, they came to the University to pursue graduate work. The greatest enrollment throughout the entire period was in physics which reached a maximum of 57 in 1931-32, 1936-37, and 1940-41. The peak for the other departments was as follows: mechanical engineering, 20 in 1932-33; civil engineering, 54 in 1931-32; architecture, 18 in 1930-31; architectural engineering, 3 in 1916-17; mining engineering, 6 in 1921-22; electrical engineering, 26 in 1931-32; theoretical and applied mechanics, 20 in 1939-40; municipal and sanitary engineering, 4 in 1915-16; railway engineering, 7 in 1915-16; ceramic engineering, 20 in 1938-39; and ceramics, 3 in 1923-25.

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1. From data in the office of the Graduate School.

[illegible]

TABLE XXX-ENROLLMENT OF GRADUATE STUDENTS IN ENGINEERING
1902 to 1945

Year	Mech. Eng.	Civil Eng.	Arch.	Arch. Eng.	Mining Eng.	Met. Eng.	Physics	Elect. Eng.	T. & A.M.	Mun.&San.Eng.	Ry. Eng.	Cer. Eng.	Ceramics	Total
1902-03														
03-04	16	12	7				2			2				39
04-05	22	16	6				2			2				48
05-06														
06-07	19	19	9				4	10		1				62
07-08	18	23	8	1			10	10		2				72
08-09	19	15	13				14	12	2		4			79
09-10	12	16	10				14	9	4		1			66
10-11	17	20	4	1			16	18	7		2			85
11-12	16	12	4				12	23	5		2			74
12-13	11	20	3	3			14	30	7		1			89
13-14	5	11	7		1		15	11	5		2			57
14-15	9	12	5	2	3		17	22	6	4	5			85

Year	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25	25-26	26-27	27-28	28-29	29-30	30-31	31-32
Mech. Eng.	13	14	11	6	6	6	12	15	14	12	19	21	17	15	19	19	19
Civil Eng.	16	14	10	6	5	9	18	15	15	18	28	30	27	22	33	37	54
Arch.	3	2	7	2	2	6	5	3	4	5	7	8	4	7	12	18	
Arch. Eng.	2	3					2	2	2				1				
Mining Eng.	4	5	2	4	1	1	6	1	2	1	2	4	1		2	4	3
Met. Eng.																	
Physics	15	18	12	14	15	12	18	24	21	20	23	26	30	34	31	48	57
Elect. Eng.	18	18	10	8	10	10	14	11	7	6	13	12	10	11	10	10	26
Theo.&App.Mech.	11	8	5	4	3	8	8	11	9	6	7	7	11	16	4	7	9
Min.&San. Eng.	4	2	1		1		1	2			2						
Ry. Eng.	7	4	2		1		3	2	3	4	4	2	1	3	4	4	6
Cer. Eng.							4	1	4	2	2	1	9	11	16	11	11
Ceramics		1	1					2	3	3	1	1					
Total	93	89	61	44	44	52	91	90	84	77	108	112	111	119	131	158	185

Year	Mech. Eng.	Civil Eng.	Arch.	Arch. Eng.	Mining Eng.	Met. Eng.	Physics	Elect. Eng.	Theo&App.Mech.	Mun..&San.Eng.	Ry. Eng.	Cer. Eng.	Ceramics	Total
32-33	20	37			3		53	22	19			8		162
33-34	17	28			4		50	15	6		3	13		136
34-35	9	40			4		47	13	9		2	8		132
35-36	2	43			1		49	12	7		4	10		128
36-37	4	35			2		57	13	9		2	9		131
37-38	8	29			1		54	10	15		2	7		126
38-39	10	32			5		50	15	17		1	20		150
39-40	14	30			3		55	13	20		2	12		149
40-41	13	31			6		57	7	11			10		135
41-42	10	19			5		45	5	7			6		97
42-43	6	22			6		54	3	4			3		98
43-44	6	33			2		44	3	6			1		95
44-45	7	32			7		19	2	8			9		84

B. ENGINEERING DEGREES

a. BACCALAUREATE DEGREES

Certificates and Degrees.-In the minds of at least some persons, the Illinois Industrial University was founded as a protest against the methods and practices of other colleges; and therefore the original state law prohibited the institution from granting diplomas and degrees, but authorized the issuing of "certificates in the English language (unless the students prefers otherwise) which shall set forth the precise attainments as ascertained by special examination, to all students in attendance for not less than one year". Students who had received 36 term credits were granted "full certificates", and such students were known as graduates; but students who had received a smaller number of term credits were given "partial certificates", and were not rated as graduates.

The alumni found themselves at a disadvantage (particularly those desiring to teach in certain states) by the lack of the usual degree as evidence of their college graduation; and hence petitioned the state legislature to authorize the University to grant the usual college degrees.

At its session of 1877 the legislature gave the necessary power; and on January 21, 1878, the faculty recommended to the Board of Trustees that students who wished to become candidates for degrees, should complete the full course of their curricula or prescribed outlines of study, and that students not candidates for degrees should be considered as special students and given certificates. The Bachelor of Science degree should be granted to those being graduated in engineering, agriculture, natural science, domestic science, and English and modern languages, and the Bachelor of Arts degree should be given only those finishing in ancient languages,-the requirements for all bachelor's degrees being unified as much as possible. The recommendation provided also, that the Master of Science degree be conferred after one year of graduate study and the presentation of an acceptable thesis. The recommendation was approved by the Board on March 12, 1878. The first degrees granted by the University, then, were in June following, the list including twenty-seven bachelor degrees and six master degrees, three of the six going to

engineers. From time to time for several years, similar master's degrees were conferred upon graduates who had distinguished themselves in professional or further study. Also from time to time honorary bachelor's degrees were conferred upon distinguished graduates of more than ten years' standing. For many years past, however, bachelor's and master's degrees have been conferred only upon those completing the prescribed conditions, as will be explained later.

In 1891, the practice was discontinued of giving a "full certificate" to all who had completed 36 term credits, but did not meet the requirements for graduation in any particular course.

Baccalaureate Degrees Conferred.-Table XXXI shows the number of baccalaureate degrees conferred by the different departments[1] in the College of Engineering from 1870 to 1945. The first class, which was graduated in 1872, contained six candidates for certificates in the College,-one in architecture, four in civil engineering, and one in mining. In 1944, there were 201 graduates representing eight different departments, and ten curricula.

The highest number graduating in any one year in mechanical engineering was 135 in 1943; civil engineering, 69 in 1930 and 1933, although there were 65 in 1910; architecture, 34 in 1915; architectural engineering, 37 in 1930; mining engineering, 11 in 1922, 1923, and 1925; metallurgical engineering, 24 in 1940 and 1941, electrical engineering, 72 in 1933; municipal and sanitary engineering, 9 in 1915; railway civil engineering, 8 in 1911 and 1926; railway electrical engineering, 10 in 1909; railway mechanical engineering, 3 in 1910, 1917, 1923, 1924, 1931, and 1939; ceramic engineering, 26 in 1941; ceramics, 13 in 1940; engineering physics, 14 in 1940; general engineering, 20 in 1941, although there were 19 in 1925; gas engineering, 2 in 1928; and agricultural engineering, 7 in 1940. The total number of baccalaureate degrees conferred up to the end of 1945 was 9607, of which mechanical engineering had 2363, civil engineering, 2357, and electrical engineering, 2099.

1. All departments of the College grant both baccalaureate and advanced degrees except the Department of General Engineering Drawing, which does not confer degrees of any kind, and the Department of Theoretical and Applied Mechanics, which confers only graduate degrees.

TABLE XXXI SUMMARY OF BACCALAUREATE DEGREES CONFERRED BY THE COLLEGE OF ENGINEERING
1870-1945

Year	Mech. Eng.	Civil Eng.	Architecture	Sanitary Eng.	Arch. Eng.	Mining Eng.	Met. Eng.	Electrical Eng.	Mun. & San. Eng.	Ry. Civ. Eng.	Ry. Elec. Eng.	Ry. Mech. Eng.	Ceramic Eng.	Ceramics	Eng. Physics	General Eng.	Gas. Eng.	Agr. Eng.	Aero. Eng.	Total
1870																				
71																				
72		4	1			1														6
73	2	5																		7
74	2	5																		7
75	2	4	1																	7
76	2	2	1																	5
77	3	6	6																	15
78	4	1	4																	9
79	1	3	1			4														9
80	5	3				1														9
81	1	5																		6
82	6	4	3																	13
83	1	7																		8
84	3	8	1																	12
85	7	5	4																	16
86	4	12	3																	19
87	9	5	2			1														17
88	3	4	3																	10
89	3	3	2																	8
90	10	9	3																	22
91	6	11	7																	24
92	4	13	7																	24
93	4	12	10					3												29
94	1	10	12			1		9	1											34
	83	141	71			8		12	1											316

Year	Mech. Eng.	Civil Engineering	Sanitary Eng.	Architecture	Arch. Eng.	Mining Eng.	Met. Eng.	Elect. Eng.	Mun.& San.Eng.	Ry. Civ. Eng.	Ry. Elect. Eng.	Ry. Mech. Eng.	Ceramic Eng.	Ceramics	Eng. Physics	General Eng.	Gas. Eng.	Agr. Eng.	Aero. Eng.	Total
Forward	83	141		71		8		12	1											316
1895	8	13		14	3			8	2											48
96	9	8		10	2			11												40
97	12	7		15	3			14	1											52
98	4	12		9	1			18	1											45
99	9	11		9	2			15	1											47
1900	10	10		8	1			8	2											39
01	12	13		6	3			8	1											43
02	18	20		8	2			7	1											56
03	17	20		8	2			6	1											54
04	32	30		10	3			20	3											98
05	28	42		6	5			13	2											96
06	33	46		11	6			27	5											128
07	52	60		10	4			35	1											162
08	28	52		11	3			30	2		6									132
09	34	57		10	6			26	6	3	10	2								154
10	46	65		12	10			42	4	2	6	3								190
11	39	61		15	14			54	6	8	1	2								200
12	37	46		16	22	2		58	5	3	4	2								195
13	26	44		25	23	5		47	5	2	2	1								180
14	45	52		33	24	6		43	7	3	3	2								218
15	37	37		34	27	6		44	9		1									195
16	44	39		27	36	3		43	5	4	4	2	5	10						222
17	40	38		26	32	8		45	8	4	4	3	8							216
18	26	20		9	18	5		30	1	5	2	1	4							121
19	16	19		7	2			20	4	4	1	1	1							75
	745	963		420	254	43		684	84	38	44	19	18	10						3322

Year	Mech. Eng.	Civil Eng.	Sanitary Eng.	Architecture	Arch. Eng.	Mining Eng.	Met. Eng.	Elec. Eng.	Mun. & San. Eng.	Ry. Civ. Eng.	Ry. Elec. Eng.	Ry. Mech. Eng.	Ceramic Eng.	Ceramics	Eng. Physics	General Eng.	Gas. Eng.	Agr. Eng.	Aero. Eng.	Total
Forward	745	963		420	254	43		684	84	38	44	19	18	10						3322
1920	34	40		19	24	5		32	2	1	6		6							169
21	38	28		12	20	7		47	2	3	4	1	2							164
22	57	61		14	17	11		55	2	3	6	2	6							234
23	71	59		19	24	11		46	2	6	5	3	13	1	1	5				266
24	61	41		8	15	10		60	5	5	7	3	17	2	2	14				250
25	43	45		8	16	11		54	3	3	7	1	11	2	2	19				225
26	42	61		13	17	5		45	6	8	4	2	7	3	1	18				232
27	24	49		8	20	6		55		7	5	1	11	4	5	10				205
28	44	58		14	28	7		66		1	9	2	14	3	1	12	2			261
29	39	62		27	34	1		69		5	1		8	4	3	19				272
30	54	69		31	37	4		61		3	9	1	11	1	2	10				293
31	48	68		24	36	2		68		4	5	3	9	1	5	13				286
32	58	63				3		55		3	4	1	9	5	5	7				213
33	66	69				4		72		2	4	2	15	2	10	13				259
34	51	60				3		70		3	4	1	12	3	7	17		2		233
35	58	47				2		54		1	2	2	4	4	8	9				191
36	46	54				4	1	59			3		14	5	9	12		2		209
37	50	45				4	9	48		3	4		14	11	3	10		7		208
38	61	58				4	1	52		2	2		21	7	7	6		4		225
39	92	40				3	16	59				3	19	7	3	12		3		257
40	101	66				7	24	58		3	3		25	13	14	12		7		333
41	110	64				6	24	67					26	9	6	20		5		337
42	117	67				2	23	55					18	6	9	17		3		317
43	135	45				3	22	51					11	3	5	18		6		299
44	76	39				2	22	29					12	1	13	5		2		201
45	42	36	21			1	3	28					3		7	5				146
Total	2363	2357	21	617	542	171	145	2099	106	104	138	47	336	107	128	283	2	41		9607

b. ADVANCED DEGREES

Academic Degrees.- Although facilities for advanced study and for research in various lines were offered by the University as early as 1872 and a few instructors had received advanced degrees for graduate study, organized instruction in graduate work was not undertaken until the administration of Acting Regent Burrill. One of first acts of Doctor Burrill was to advocate the establishment of formal graduate courses; and as the result of his efforts, a Graduate School was established in 1891-92, with provisions for conferring the master's degree. On March 3, 1893, the Board of Trustees voted to authorize courses leading to the degrees of Ph. D. and Sc. D. In 1894, the administration of the Graduate School was placed in charge of the Council of Administration and under the immediate supervision of the Vice-President of the University. In 1906, the Graduate School was organized as a separate faculty consisting of the Dean and such members of the University faculty as were assigned to this duty by the President. By action of the Board of Trustees of the University, the teaching faculty of the Graduate School has been made to include all members of the University faculty who give instruction in approved graduate courses. The affairs of the School are in charge of its executive faculty, all members of which except the President of the University and the Dean are elected by the staff of the School.

After 1894, no graduate degrees were granted except to those who had completed in residence a prescribed number of courses equivalent to one full year's work, or who had had at least three years' of approved practical experience. In either case an acceptable thesis was required.

In 1908, the University Senate revised somewhat the conditions under which the second academic degree were conferred. The 1908-09 copy of the Register contained the following statement; "The academic degree in engineering is Master of Science, following Bachelor of Science, in Architecture, Architectural Engineering, Civil Engineering, Electrical Engineering, etc. This degree is conferred in accordance with regulation prescribed above for work in residence only."

Students in the Department of Physics were the first in the College of Engineering to undertake on any scale, work on the graduate level. Shortly after the Graduate School was organized in 1891-92, and particularly after its reorganization in 1906, the Department of Physics had a comparatively large number of students pursuing graduate work as a preparation for teaching the subject of physics; and many of them received the doctor's degree.

Only a few graduates from other departments in the College of Engineering pursued graduate work in residence, because they were usually anxious to begin practical work, in which desire they were probably wise, for the reasons that they had been four years under educational guidance and would be benefited by applying their knowledge in practical work, and that the College of Engineering was not then adequately equipped in staff or appliances to make an attractive appeal to students for graduate study, particularly as the number of undergraduates was sufficient to require practically all of the time of the staff and the equipment.

A comparatively few engineering instructors by doing a little graduate work each semester in addition to their teaching, ultimately obtained their master's degree; and now and then one thus obtained a doctor's degree.

As engineering science and practice developed and expanded in multitudinous ways, it became increasingly evident that the standard four-year curricula did not provide time for more than a thorough education in the underlying physical and mathematical sciences and a moderate amount of application of these sciences to problems of design, construction, and operation, together with a substantial groundwork in language, social sciences, and some of the arts; that there was little opportunity in the four-year program for advanced work in engineering science; and that one or more years of work on the graduate level would be required to secure requisite training in engineering subjects. Gradually the staff was strengthened from time to time in accordance with this idea and appropriate courses listed to meet this need,-the most rapid expansion of graduate work occurring after 1920, for about that time there developed a greater demand for men having more advanced training in the science and technology of engineering.

For some time now each department in the College of Engineering has been provided with facilities and a competent staff to conduct graduate study in almost all phases of its field of engineering interest. The time ordinarily required for the master's degree is one full year and that for the doctor's degree is three full years after the baccalaureate degree, with emphasis upon a thesis presented in suitable manner.

Many of the younger members of the regular teaching and research staffs devote as much time as they can spare from their University duties to taking part-time work of about one unit a semester towards an advanced degree.

All-University Graduate-School Fellowships.-The first Graduate-School fellowship was offered in 1892. Later, there were six all-University fellowships, each with an annual stipend of $400, and still later, there were eight, at $300. The purpose of these fellowships was to promote advanced scholarship and original research. Students in engineering were eligible for consideration in making the fellowship awards on the same basis as students in other fields.

Engineering Research Fellowships.-Although the Engineering Experiment Station was organized in 1903, as stated elsewhere in this publication, the Station had little more than a paper existence until the appropriation of 1905 permitted the extension of the staff and the equipment of the College to inaugurate a comprehensive program of research in engineering. It was soon apparent that with the development of the Engineering Experiment Station there would be an opportunity to train, and at the same time to utilize the services of graduate engineering students; but it was found to be impossible to persuade desirable engineering students to engage in such work, even though the University offered scholarships carrying a stipend of $300 per year, since engineering practice offered more tempting pecuniary inducements. Besides, it was forseen that a student engaging in such work for only one year would not be of much help in research work.. Therefore, at the request of the Staff of the Station, the Board of Trustees shortly after the receipt of the special appropriation in 1907 for the Graduate School, offered ten engineering research fellow-

ships with an annual value of $500 each,[1] with the stipulation that they must be accepted for two successive years. These fellowships were then and are still open to the graduates of any approved engineering college. Students accepting them become members of the Graduate School, but do their work in the College of Engineering. Not infrequently, these fellowships are taken by graduates who have had several years of practical experience.

The rules provide that a research fellow shall give half of his time to work for the Station and half to advance study, and in many cases this is done; but sometimes the nature of the research work or experimental investigation is such that the student gladly, and with high profit to his own education and training, devotes his whole time to the problem in hand, under the direction of the one in charge of the investigation.

In connection with the formal installation of Dr. W. F. M. Goss as Dean of the College of Engineering, February 4-5, 1908, a convocation was held to celebrate the formal opening of the reorganized Graduate School at which was emphasized the importance of graduate study in the highest development of the University. An explanation was made of the value of research to the progress of the life of the State, and attention was called to the unusual opportnnities for advance study and investigation at the University, particularly in connection with the Engineering Experiment Station. After the publicity obtained through this meeting and through the publication of the bulletins of the Station, there was not much difficulty in securing desirable men from our own or other institutions for the engineering research fellowships; and usually it was possible to select promising men who had had one or more years of practical experience. Such students have been very helpful in carrying on the research work of the Station, and the training they have thus obtained has made it possible for them to secure positions of responsibility in engineering practice or as research workers in the industries, and has enabled them to render exceedingly valuable service after leaving the University. Further, the presence of such men about the College has been a stimlus and inspiration to undergraduate engineering

1. The number was later increased to fourteen and the value to $600, as described in the next chapter.

students. Some really distinguished engineers of foreign countries have sought these fellowships because of the opportunities of research and experimental investigations.

Masters' Degrees Conferred.- Table XXXII shows the summary of masters' degrees conferred by the Graduate School. Both A.M. and M.S. degrees were granted in physics, the A.M. to students outside of the College of Engineering and M.S. to those within the College.[1] Of the total 829 M.S. degrees conferred during the period 1906-45, 239 were on students in civil engineering. The next largest was physics with 159. Then followed, in turn, electrical engineering with 131, theoretical and applied mechanics with 87, mechanical engineering with 86, ceramic engineering with 46, railway engineering with 28, architecture with 15, ceramics with 14, mining engineering with 11, architectural engineering and municipal and sanitary engineering each with 5 and metallurgical engineering with 3.

The peak in civil engineering was 23 in 1932; in physics, 15 in 1937; in electrical engineering, 10 in 1932; in theoretical and applied mechanics, 8 in 1929; in mechanical engineering, 10 in 1934; in ceramic engineering, 6 in 1929; in railway engineering, 3 in 1932 and 1939; in architecture, 3 in 1930; in ceramics, 3 in 1940; and in mining engineering, 2 in 1932.

1. Only the M.S. degree was granted to students in other departments of the College.

TABLE XXXII - SUMMARY OF MASTERS[1] DEGREES CONFERRED BY THE GRADUATE SCHOOL ON STUDENTS IN ENGINEERING AND ENGINEERING MAJORS
1906 to 1945

Year	Mech. Eng.	Civil Eng.	Arch.	Arch. Eng.	Mining Eng.	Met. Eng.	Physics		Elect. Eng.	T. & App. Mech.	M. & San. Eng.	Ry. Eng.	Cer. Eng.	Ceramics	Total	
	M.S.	M.S.	M.S.	M.S.	M.S.	M.S.	A.M.	M.S.	M.S.	M.S.	M.S.	M.S.	M.S.	M.S.	A.M.	M.S.
1906							2								2	
07																
08							2	1							2	1
09	2	1					6	1	2			2			6	8
10			1				1		2	2				1	1	6
11	1	2					1	2	4	2					1	11
12	1	1	1					1	11	1					0	16
13	3	2		1			3	1	17	2		1			3	27
14		1	1	1			4	2	3	3					4	11
15		2	1		1		2	2	8	3		3			2	20
16	3	4	1				2	1	3	3		1	3		2	19
17		1		1			3		4	4	1	1			3	12
18	1	3	1				1	1							1	6
19	1						2		1	1					2	3
	12	17	6	3	1		29	12	55	21	1	8	3	1	29	140

1. From the records in the Graduate School office.

Year	Mech. Eng.	Civil Eng.	Sanitary Eng.	Arch.	Arch. Eng.	Mining Eng.	Met. Eng.	Physics		Elec. Eng.	T. & A.M.	Mun.&San.Eng.	Ry. Eng.	Cer. Eng.	Ceramics	Total	
	M.S.	M.S.	M.S.	M.S.	M.S.	M.S.	M.S.	A.M.	M.S.	M.S.	M.S.	M.S.	M.S.	M.S.	M.S.	A.M.	M.S.
Forward	12	17		6	3	1		29	12	55	21	1	8	3	1	29	140
1920		2						4	3	1	1					4	7
21	2							1	1	1	2					1	6
22	2	1		1					2	2	1	1				0	10
23	1	2				1		4	2	2	2	1	1		1	4	13
24	6	3		1	1	1		2	4	1	2		2	1	1	2	23
25	2	7			1	1		2	1	2	2			1		2	17
26	1	5		1				1	3		2	1	1	1		1	15
27	5	6				1		1	1	1		1	2	1		1	18
28	3	10		1				2	9	2	3		1	1		2	30
29	2	4		2				1	4	4	8			6		1	30
30	6	11		3				2	8	6	1		1	3		2	39
31	6	11				1		3	2	3	5		2	4		3	34
32		23				2		3	7	10	5		3	3	1	3	54
33	9	19				1		7	12	9	2			2		7	54
34	10	14						5	5	6	1		1	4		5	41
35		13						3	3		3		1	1		3	21
36	1	14						2	8	6	3			1	1	2	34
	68	162		15	5	9		72	87	111	64	5	23	32	5	72	586

Year	Mech. Eng.	Civil Eng.	Sanitary Eng.	Arch.	Arch. Eng.	Mining Eng.	Met. Eng.	Physics		Elect. Eng.	Th. & App. Mech.	Mun. & San. Eng.	Ry. Eng.	Cer. Eng.	Ceramics	Total	
	M.S.	M.S.		M.S.	M.S.	M.S.	M.S.	A.M.	M.S.	M.S.	M.S.	M.S.	M.S.	M.S.	M.S.	A.M.	M.S.
Forward	68	162		15	5	9		72	87	111	64	5	23	32	5	72	586
1937		15						4	15	3			3	2	1	4	39
38	3	10				1		5	9	3	6				1	5	33
39	3	10				1		1	11	8	3		1	3	2	1	42
40	2	13							6	3	6		1	5	3	0	39
41	4	13					1	4	11	2	5			1		4	37
42	3	5						4	6		1			1	2	4	18
43		6					1	5	8							5	15
44	1	1							6	1	1						10
45	2	4					1				1			2			10
Total	86	239		15	5	11	3	95	159	131	87	5	28	46	14	95	829

Professional Degrees.-After the Graduate School was established in 1892, the Register[1] carried the following statement:

"The master's degrees, M.A., M.L., and M.S., and the equivalent degrees of civil engineer, mechanical engineer, etc. will be given, after 1894, to graduates of this or other similar institution who have pursued at the University a year of prescribed graduate studies and have passed examinations thereon, or who have pursued as non-residents three years of such study and have passed the required examinations."

In 1908, the University Senate revised somewhat the rules for conferring the professional degrees. The 1908-09 issue of the Register contained the following statement in this connection: "The professional second degrees in engineering are as follows:[2]

Master of Architecture after B.S. in Architecture

Architectural Engineer after B.S. in Architectural Engineering

Civil Engineer after B.S. in Civil Engineering

Electrical Engineer after B.S. in Electrical Engineering

Mechanical Engineer after B.S. in Mechanical Engineering

Civil Engineer after B.S. in Municipal and Sanitary Engineering

Civil, Electrical, or Mechanical Engineer after B.S. in Railway Engineering according to the course.

"Professional degrees are conferred upon graduates of the College of Engineering of the University of Illinois who have been engaged in acceptable professional work for a period of not less than three years after receiving the degree of Bachelor of Science. In 'acceptable professional work' may be included contributions to technical literature, activity in professional societies, investigations of engineering problems, and the teaching of engineering subjects.

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1. 1894-95, page 157..
2. In 1929-30, authority was granted for conferring the professional degree of Engineer-Physicist after the B.S. degree in Engineering Physics, and in 1943-44, of Aeronautical Engineer after the B.S. degree in Aeronautical Engineering.

"Candidates for professional engineering degrees who already hold the degree of Master of Science, may qualify for the professional degree after two years of professional work, other conditions being the same as those prescribed for candidates holding the degree of Bachelor of Science."

In 1927-28, the time limit of experience was changed from three to four years of professional practice after the Bachelor of Science degree, three years of which must be in responsible charge of engineering work.

One of the requirements that has always been requisite for the professional degree has been that the candidate must present a satisfactory thesis describing some engineering project with which he has been connected or discussing some problem of engineering design.

In the course of the years, a considerable number of engineering graduates have obtained such degrees. A substantial proportion of these have been teachers engaged in University work, but an even greater percentage includes men engaged in professional practice.

Professional Degrees Conferred.-Table XXXIII gives a summary of professional degrees in engineering granted by the Graduate School from 1891 to 1945. The peak in mechanical engineering was 7 in 1909; in civil engineering, 10 in 1916; in architecture, 3 in 1910 and 1925; in architectural engineering, 2 in 1894; and in electrical engineering, 7 in 1911. The total number of degrees for the period was 88 in mechanical engineering, 148 in civil engineering, 25 in architecture and 6 in architectural engineering up to 1931, 6 in mining engineering, 95 in electrical engineering, 9 in ceramic engineering, and 3 in physics, making a grand total of 381.

TABLE XXXIII - SUMMARY OF PROFESSIONAL DEGREES IN ENGINEERING CONFERRED BY THE GRADUATE SCHOOL, 1891 to 1945

Year	Mech. Eng.	Civil Eng.	M. Arch..	Arch.. Eng.	Eng. Mines	Met. Eng.	Elect. Eng.	Cer. Eng.	Eng. Phys.	Total
1891		2								2
92										
93		1								1
94		2		2						4
95	2	2	1							5
96							1			1
97		1		1			1			3
98	1	1	1							3
99	2									2
00	2	2	1				1			6
01	2						1			3
02	1	1								2
03			2							2
04	2		1							3
05	4	1	1							6
06	5	2		1						8
07	3	3					1			7
08		1	1				1			3
09	7	8	2				3			20
	31	27	10	4			9			81

Year	Mech. Eng.	Civil Engineer	M. Arch.	Arch. Eng.	Eng. Mines	Elect. Eng.	Cer. Eng.	Eng. Physics	Total
Forward	31	27	10	4		9			81
1910	3	4	3			3			13
11	4	8				7			19
12	4	3				1			8
13	2	5				5			12
14		4	2			2			8
15	1	3	1			3			8
16	5	10			1	5			21
17	2	8				5			15
18		2	1	1		1			5
19	1	1				3			5
20	1		1			3			5
21	2	3	1		1	3			10
22	1	6	1			3			11
23	3	1				1			5
24		1				1			2
25		3	3			3			9
26	2	3	1			4	1		11
27	2	4			1	1			8
28	1	4		1		6			12
29	4	2				2			8
30	2	2				2			6
31	1	3	1		1			1	7
	72	107	25	6	4	73	1	1	289

Year	Mach. Eng.	Civil Eng.	M. Arch.	Arch. Eng.	Eng. Mines	Elect. Eng.	Cer. Eng.	Eng. Physics	Total
Forward	72	107	25	6	4	73	1	1	289
1932	4	4				2			10
33		2				2	2		6
34	1	2			1	1			5
35	2				1	1			4
36		6				1		1	8
37	1	3				1			5
38	1	3				2	1		7
39	1	3				2	1		7
40	1	5				3	1	1	11
41	1	4				5			10
42	2	4					1		7
43	2	3							5
44		1			1		1		3
45		1				2	1		4
	88	148	25	6	7	95	9	3	381

Doctorate Degrees.-The only doctorate degrees that have been granted in engineering at the University of Illinois have been those of Ph. D. The minimum requirements for this degree have been three years of intensive work in residence including a thesis that presents a formal report which embodies the solution of some problem requiring original design, research,,or analysis and which may be considered a real contribution to the fund of knowledge in the particular field of major interest. Only students of superior ability are permitted to undertake work for the doctorate. The number admitted as candidates is relatively small, although throughout the years the percentage has gradually increased. Physics, of course, leads as would be expected, for the Ph. D. Degree is almost prerequisite to appointment to teaching positions on a university or college level.

Ph. D. Degrees Conferred.- Table XXXIV summarizes the Ph. D. degrees in engineering granted by the University, with majors in the departments listed. Of the 157 degrees conferred from 1910 to 1945, 100 were for majors in physics, 20 in civil engineering, 15 in ceramic engineering, 6 in electrical engineering, 6 each in mechanical engineering and theoretical and applied mechanics, 2 in mining engineering, and 1 each in railway engineering and ceramics. The greatestnumber in any one year in all departments was 13 in 1936.

TABLE XXXIV - SUMMARY OF Ph. D. DEGREES IN ENGINEERING CONFERRED BY THE GRADUATE SCHOOL WITH MAJORS IN DEPARTMENTS INDICATED, 1910 to 1945 [1]

Year	Mech. Eng.	Civ. Eng.	Mining Eng.	Met. Eng.	Physics	Elect. Eng.	Th. & App. Mech.	Ry. Eng.	Cer. Eng.	Ceramics	Total
1910											
11											
12					3						3
13					1						1
14					2	1	1				4
15					1		1				2
16		1			2						3
17					1			1			2
18					2						2
19											0
20					1						1
21					2						2
22					2						2
23					1						1
24	1				2						3
25											0
26		1			6						7
27	1	1			1						3
Total	2	3			27	1	2	1			36

1. From the records in the Graduate School Office.

Year	Mech. Eng.	Civil Eng.	Mining Eng.	Met. Eng.	Physics	Elect. Eng.	Th. & App. Mech.	Ry. Eng.	Cer. Eng.	Ceramics	Total
Forward	2	3			27	1	2	1			36
1928			1		4						5
29					2						2
30					3						3
31					2						2
32	1				5						6
33					5		1				6
34					2						2
35		2	1		3	1					7
36	1	1			6	1	1		3		13
37		1			9				1		11
38		1			2	1			1		5
39					3				3	1	7
40		2			5	2			1		10
41		1			8				2		11
42	1				7		1		2		11
43		3			3						6
44	1	1			3		1		1		7
45		5			1				1		7
Total	6	20	2		100	6	6	1	15	1	157

Honorary Degrees.-Table XXXV gives a summary of the honorary degrees in engineering conferred by the University. Of the twenty-two degrees granted between 1892 and 1911, eleven were D. Eng., one was D. Arch., eight were C.E., and two were M.E. No honorary degrees of any kind were given by the University from 1912 to 1928 inclusive. The degree of LL.D. was conferred upon an alumnus in 1929 and upon a faculty member in 1931. No honorary degrees have been granted since then. The list of the twenty-four persons honored and their degrees is given in Table XXXVI.

TABLE XXXV - SUMMARY OF HONORARY DEGREES IN ENGINEERING

Year	D. Eng.	D. Arch.	C.E.	M.E.	LL.D.
1892			4		
1893			1	1	
1894			2		
1895					
1896					
1897					
1898					
1899					
1900		1			
1901					
1902					
1903	4				
1904	2				
1905	2		1	1	
1906					
1907					
1908					
1909					
1910	2				
1911	1				
1929					1
1931					1
Total	11	1	8	2	2

Grand Total - 24

TABLE XXXVI - RECIPIENTS OF HONORARY DEGREES

Year	Name	
1892	Charles Wright Clark,	C.E. degree
	Charles Gleason Elliott	" "
	William C. Ells	" "
	Andrew T. Morrow	" "
1893	Harvey C. Estep	" "
	Elna Alphonso Robinson	M.E. degree
1894	Elijah Newton Porterfield	C.E. degree
	George Story	" "
1900	Nathan Clifford Ricker	D. Arch. degree
1903	Ira Osborn Baker	D. Eng. degree
	Richard Price Morgan	" "
	John Augustus Ockerson	" "
	Samuel Wesley Stratton	" "
1904	Lincoln Bush	" "
	William Freeman Myrick Goss	" "
1905	Octave Chanute	" "
	John Victor Emanuel Schaefer	M.E. degree
	Frederick Eugene Turneaure	D. Eng. degree
	August Zeising	C.E. degree
1910	Lester Paige Breckenridge	D. Eng. degree
	Isham Randolph	" "
1911	Ralph Modjeski	" "
1929	William Lamont Abbott	LL.D. degree
1931	Arthur Newell Talbot	" "

C. ALUMNI RECORDS

General.-Since the principal function of the College of Engineering is the training of men for service in the engineering industries, the value of the work of the institution is indicated, in part at least, by the number of its students and graduates who have entered industrial life. For somewhat obvious reasons, it is not practical for the University to keep track of the occupations of students who leave college before graduation; and therefore the chief data at hand on this subject concern only those who have completed at least one of the listed curricula.

Professional Records.-The crowning test of the efficacy of any educational institution is marked by the records of professional achievement of the men who have been trained in that institution. The College of Engineering here can take justifiable pride in the high place earned for it through its accomplishments in this direction. For the long list of graduates who have been so trained and inspired by the educational facilities provided by the College that they have attained positions of merit and responsibility in the engineering profession and in industry generally,--many not only in this country, but also in practically every civilized nation abroad, having thereby earned for themselves national recognition in their particular lines of technology,-indicates that the University has done a creditable job in performing the fundamental service and in fulfilling the aims for which it was established.

Because of the extraordinarily large number involved, it is not possible to include even the names of the engineering alumni, much less cite their records of achievement. Those who have been connected with the College faculty with the rank of instructor or above, are, of course, listed in their respective departments. Many of the other alumni, especially the older ones, are, however, included in the rosters of the several who's who and other responsible compilations giving biographical sketches of persons prominent in some field of human effort, particularly in those that concern positions of responsibility in the management of private and public enterprise; in the design, construction, and operation of industrial properties and public utilities; and in the conduct of educational institutions.

<u>Geographical Distribution of Graduates.</u>--It is exceedingly difficult to obtain reliable information concerning the location of graduates because the average response to questionnaires is only about one-third, and because many of the replies are not specific. The matter is further complicated by the fact that in passing through two great wars, many of the graduates were in military service and subsequently changed their locations, while still others changed because of the varying demands and opportunities of industry brought on by the wars. Even though in past years, the College of Engineering has made an honest effort to collect such data, the records are far from satisfactory and complete. No attempt has been made, therefore, to present a geographical summary showing the distribution of alumni as they are now located in industry and war assignments.

<u>Vocational or Occupational Distribution of Graduates</u>.-For the very same reasons as given in the preceding paragraph, the records of vocational distribution of graduates is even more difficult to maintain that those of geographical location. Therefore, no attempt has been made here to summarize the numbers engaged in the several lines of engineering practice.

CHAPTER XXVIII

A SUMMARY OF THREE-QUARTERS OF A CENTURY OF PROGRESS

General.-It is now proposed to consider some of the leading developments during the past seventy-five years that are related to the growth of the College of Engineering, in order the better to appreciate the expansion of the institution and the more intelligently to interpret its present function and its future possibilities. ~~The~~ The three-quarters of"a century of progress which have passed since the opening of the University of Illinois have been of marvelous achievement in engineering and science, and in their application to the development of industry. During this period, Engineering was advanced from an art to a science. It is now recognized as a profession which is indispensable to the maintenance and growth of modern civilization."[1] The College of Engineering at the University of Illinois has made a substantial contribution towards the realization of this goal. Its attainments have no doubt far surpassed the most visionary dreams of those who founded the institution, and its achievements have been brought about not only by its own intelligent direction towards intellectual and educational objectives, but also by many external contributing influences, some of which are discussed in the following pages.

A. CHANGES IN EXTERNAL FACTORS THAT HAVE INFLUENCED THE GROWTH OF THE COLLEGE

General.-The customs and traditions of any great public educational institution are inseparably linked to the life of the community or region which it was established to serve, and are gradually evolved as the social order of that section develops morally, intellectually, culturally, and professionally. Thus, it is that the growth of the University and the progress of the College of Engineering have gone on simultaneously with the development of the Urbana and Champaign communities, of the State of Illinois, and even of many interests in the Nation at large.

The Development of the Local Community.-In some respects the location of the University was quite unpromising. In 1870, Urbana had a population of 2 277 and Champaign, 4 625,-less than one-fourth of what they are in 1945. Both towns were of the country-village type, with no pavements, no water-works, and no sewers.

1. "A Pictorial Description of the College of Engineering," page 7.

The residences were small, and mostly heated by stoves. The lawns had no shrubbery and were surrounded by unsightly fences, which were frequently broken down by the illy-fed and breachy cows which ran at large. The only public transportation was a horse-car line that made half-hourly trips between the business sections of the two towns, as mentioned previously. In neither of these business districts was there more than two or three brick buildings. On the Urbana side between the campus and Lincoln Avenue there were not more than six or eight houses. North of Springfield Avenue was open commons producing a luxuriant crop of dog fennel and other weeds, while between Springfield Avenue and Green Street there were a half dozen houses, and south of Green Street the land was occupied by cornfields. On the Champaign side, there were very few houses between Wright and First Streets in the regions between University and Springfield Avenues, and only four or five houses south of Springfield.

Now the Twin Cities constitute practically one community of about 40,000 population exclusive of University students having many commodious and attractive houses with an unusual proportion of artistically-planted and well-cared-for lawns; many miles of smooth, clean, and durable pavements; numerous parks and playgrounds; an abundant supply of water for domestic and industrial use; and an adequate sanitary system,-all equal, or superior, to those of any city of similar population. The community is well supplied, too, with a good representation of churches and theaters, with a splendid public-school system, and with an ample number of up-to-date stores and shops in its business sections.

Developments within the State. In 1870, the population of the entire State was only about two and a half millions as compared with seven and a half millions now,-the population of Chic..go being less than three hundred thousand as compared with more than ten times that number today.

Large tracts of native prairie land in Champaign and adjoining counties were uncultivated at that time (some say as much as half), and large areas were untillable because covered with swamps and ponds. Due to the unsanitary condition of the country, many of the inhabitants regularly in the summer and fall seasons had a siege

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of ague or fevers and chills. Land which was suitable for tilling sold for from $30 to $40 an acre in currency, or less in gold. Central Illinois was to a considerable extent in a pioneer stage, luxuries were few, and money was scarce.

The list of accredited high schools in the University catalogue for 1880-81, the first publication of such a list, contained 28 schools. Presumably, practically all schools met the "conditions for admission to some one college of the University", and in many cases, these schools offered only three-year curricula. In 1944, the list of accredited high schools embraced 896, all offering four-year curricula and all being in every respect very much superior to those of 1870. Many of the later schools were born full-fledged, while most of the first ones had to struggle through many long weary years to rise successfully from a one-year to a four-year-curriculum status, and acquire adequate facilities in buildings, equipment, and number and quality of teaching staff.

In comparison with other western states, Illinois was well supplied with railroads in 1870 so far as numbers were concerned, although only two of the lines crossed Champaign County. The Illinois Central, which had been constructed through Champaign only fifteen years before, ran two passenger trains a day each way,-one each way at 2 p.m. and at 2 a.m. A train consisted of a combined baggage, express, and mail car, a smoking car, and a "ladies car". The cars were heated by wood stoves, lighted by kerosene lamps, operated by hand brakes, and were connected by means of the link-and-pin coupler. The locomotives burned wood. It took five hours to make the trip from Champaign to Chicago.

The railway mileage in the State then was only about half what it is now; and the railways of that date were to those of today about as the two short, slow, jerky trains of the Illinois Central described above are to the fourteen long, heavy, modernly-equipped, comfortable, fast passenger trains that that line operates today.

Outside of the cities, there were few highways in Illinois in 1870 that could be regarded as suitable for all-season service. About 1918, however, the State undertook to develop its roads by funds provided by means of a bond issue

that resulted through the efforts of later issues in the production of a state-wide, hardroad system for highway travel over trunk-line and secondary routes that ranks second to none in this country.

The great industrial interest in the Chicago, Peoria, Moline, and East St. Louis regions had scarcely begun their operations in 1870. The increasing production of oil and coal, two major resources of the down-state areas, has contributed very materially to the creation of the wealth of the State. The development of the clay industries has advanced through the last two or three decades to become one of the leading influences in the State's prosperity.

Developments in the Engineering Profession.-Closely related to the increase in numbers of engineers and to the development of technical education is the growth of engineering societies. In 1870, there were only four technical engineering societies in this country, and all of these were quite small and of little influence,-the American Society of Civil Engineers, for example having only 160 members at that time. In contrast, there are in 1945, about 175 technical engineering organizations, exclusive of student chapters or branches and of purely social clubs.

In 1870, the only publications in the interest of professional engineering were two monthly magazines, Van Nostrand's Engineering Magazine and the Journal of Franklin Institute, both of which were as much scientific as engineering, and one or two weekly journals devoted to railway matters, which gave only a little attention to professional-engineering subjects. At that time, there was not much to be recorded or discussed, for there were only a few engineers, and not many of those had had technical training either in engineering or in writing.

At the present time, all of the technical societies publish monthly proceedings containing many valuable technical papers. In addition, there are long lists of weekly, semi-monthly, monthly, and quarterly magazines printed regularly in this country in the interests of technical engineering. Furthermore, numerous monographs, pamphlets and reports are being continuously issued by manufacturers and dealers in engineering materials. Besides, the forty-seven engineering experiment stations located in land-grant universities and colleges in this country are continuously

occupied in publishing the results of research in different fields of engineering science. Finally, federal bureaus and agencies are continuously sending forth scientific publications of interest to the profession of engineering.

In 1870, there were practically no books upon either the art or science of engineering; and of engineering textbooks, there were only two or three. At the present time, there is practically no limit to the number of textbooks available in theory and practice on the different phases of work in the engineering profession.

Developments in the Nation's Industry in General.-Probably the chief engineering industry in 1870 was the railroad, although the nation's mileage at that time was little over 33 000. During the next fifty years this was increased to about 260 000; and while the mileage has even been reduced during the past quarter century, the track, rolling equipment, and train speeds have been greatly improved. The period 1868-1945 witnessed a marvelous development in the production, transmission, and utilization of electric power, and in communication, electronics, and illumination. It also saw the development of the steam turbine in industrial-power production, and the internal-combustion engine in the automobile and aeronautical industries. During this period, too, there was a phenomenal growth in the production of engineering materials, especially in steels and alloys, concrete and reinforced concrete, copper, aluminum, and certain ceramic products. Similarly, the growth of the chemical-engineering industries was no less than phenomenal. Likewise, modern heating, ventilating, air-conditioning, and mechanical refrigeration,-all products of this period,-have made marvelous strides in improving living conditions and the general social order. The outstanding achievements, also, in the production of farm machinery have increased the possibilities of crop production. Mass-production methods have been largely responsible for the extraordinary output of goods and services which the American people have come to enjoy and to consider as commonplace experience.

B. CHANGES WITHIN THE UNIVERSITY IT SELF THAT REPRESENT PROGRESS

General.-It is now proposed to summarize briefly the records of transformations that

have come about within the University in general and the College of Engineering in particular during the seventy-five years of growth and development of this educational plant.

Growth on the Urbana Campus.-In the beginning, the University campus consisted of what is now the north half of the old athletic field, and contained a single five-story brick building, which was at once recitation building, library, chemical laboratory, chapel, and dormitory. On the southeast corner of Wright Street and Springfield Avenue stood a one-story frame building used for a tool-room, the lower story of which in 1870 became a machine shop to which a second story was added for a University carpenter's repair shop. At first, the campus terrain was little better than an abandoned brick yard; but mainly through the enforced but remunerative labor of the students, it was during the first year drained, graded, and planted so as to present a reasonably-good appearance.

The present campus was carved out of a cornfield and vegetable garden; and although many university campuses have better natural topographical features, none are more pleasing in general appearance because of the artistic planting of trees, vines, shrubbery, and flowers, and particularly because of the painstaking care with which all are maintained.

The 10 acres in the original campus have been increased to 400 in 1945. In addition, the University now owns 1 438 acres in agricultural experimental land and timber tracts and 762 acres in the airport. This land comprises an investment of about $1 530 000,- $700 000 of which represents the campus proper; $580 000, the experimental farms and timber lands; and $250 000, the airport.

The two buildings of 1867 have grown to seventy-six today devoted to education and research, to say nothing of farm and other service buildings; and the quality and equipment of the buildings have grown even in greater proportion than this increase in number. The investment in these structures represents a total of about $22 000 000.

The instructional, experimental, and administrative staffs at Urbana increased from a bare half dozen for the few simply-organized departments in 1867, to about

2 200 for the seven colleges and four schools in 1940, and to about 500 for the service, operating, and purely clerical staffs at that time. The student enrollment increased from about 50 in 1867 to something over 16 000 in 1940.[1]

Growth on the Chicago Campus.-The present Chicago campus proper comprising an area of about 11 acres, is a comparatively recent development,--the oldest building there having been erected in 1925. The cost of this land represents an investment of about $572 000.

The instructional, experimental, and hospital facilities include six major buildings representing a financial outlay of approximately $7 345 000. In addition, the State Department of Public Welfare has two major buildings, completed in 1930 and 1939 at a cost of $1 684 000. The Illinois Neuropsychiatric Institute and the Institute for Juvenile Research occupy important locations on the Chicago campus, but are still owned by the Department of Public Welfare. The University, however, does control the instructional and experimental work carried on at these two institutions.[2]

In 1940, the instructional staffs of these three colleges totaled 581, while the student enrollment was approximately 1 200.

General Educational Achievements.-For more than three-quarters of a century, the University of Illinois has been offering an ever-expanding program of educational services to the people of the State in the fields of arts, business, law, health, science and technology. In formulating its plans for these service programs, the institution has always recognized that its primary and foremost obligations were to provide instruction and training for its resident students. In the early days, it was necessary to make provision only for those of undergraduate grade, but in later years it became essential to give consideration to those on the graduate level as well. Within recent times, in addition, the University has been able to carry its instructional programs to other communities of the State through its extension and correspondence facilities. That the attainments of these commitments have been more

1. Report on Post-War Proposed Building Program, July 1, 1944, pages 13, 14.
2. Ibid. page 121.

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than moderately successful is attested by the long list of men and women trained here who have rendered distinguished services not only within the State, but throughout other sections of this country and in foreign lands as well.

The second most important responsibility of the University lies in the field of research. In following up this line of activity, the institution has made along list of outstanding contributions to the areas of knowledge in both theory and practice through its established experimental station, bureau, and health-service facilities. The third line of activity which the University undertakes to carry on is in public service expressed through its extension work and radio-broadcasting programs. In this line of endeavor, it has provided substantial returns to individuals and organizations throughout the commonwealth by supplying educational programs and professional services to meet general and specific needs.

C. CHANGES WITHIN THE COLLEGE OF ENGINEERING

a. Physical Plant

Growth of the Engineering Physical Plant.-The number of major buildings dedicated primarily to Engineering College purposes increased from two in 1871 to fifteen in 1945. The total cost of these buildings including some rearrangement and remodelling is approximately $1 644 000 according to the following schedule:

BUILDING	COST	YEAR CONSTRUCTED, REARRANGED, OR REMODELLED
Arthur Newell Talbot Laboratory	$436 848	1928-29
Ceramics including Kiln House	139 306	1913, 1915-16
Civil Engineering Surveying	29 762	1904-05, 1923
Electrical Engineering	145 723	1898, 1929
Electrical Engineering Annex	22 701	1898
Engineering Hall	170 453	1894
Locomotive or Aeronautical Laboratory	34 509	1912
Mechanical Engineering Laboratory	91 071	1905,1910,1917,1929
Machine Tool Laboratory	22 954	1895
Mining and Metallurgical Laboratory	77 473	1913, 1936
Nuclear Radiations Laboratory	36 951	1931
Sanitary Engineering Laboratory	47 800	1943
Transportation	168 305	1912, 1921
Wood-Shop and Foundry	43 392	1901-02
Physics	223 814	1909
Total	$1691 062	

The equipment provided for educational and experimental practice has been gradually accumulated through the years whenever finances and other controlling

conditions have warranted its purchase. Some of it on hand and in use now is old and some relatively new, and represents a total cost of approximately $1,258,000 according to the 1944 records of the University Comptroller. New facilities are added, of course, as rapidly as possible, but the University has had to continue to utilize what materials it had to best advantage under the prevailing conditions, because unlike many modern industrial organizations, it has not been able to replace all of its old equipment on any calculated basis of engineering economy.

b. FACULTY

Growth of the Engineering Faculty.-The size of the College of Engineering staff increased from one professor and one or two shop assistants in 1870 to a total of 220 in 1940, of whom a little over 100 were of professorial rank. The experiences of this cosmopolitan staff which has gradually increased in size through the years and which had its preliminary training and teaching practice in many schools of the land, has served as a splendid background in moulding the education and experimental system now in operation in this College. That the University here has served as an excellent proving and training ground, has long been known by other schools and by industry in general, for the more lucrative salaries that they have been able to offer have drawn from this College many of the outstanding workers to those educational institutions or industrial establishments. This is not to say that the College has in many cases suffered irreparable losses on account of such changes, for other and sometimes younger men of promise have consistently come along to take their places that have quickly attained eminence in their particular fields.

Membership of the Engineering Faculty in Technical Societies.-Table XXXVII shows the membership of the Engineering Faculty by ten-year periods since 1880, in the leading technical and scientific societies of the State and Union.

TABLE XXXVII-Membership of the Engineering Faculty in the Leading Technical and Scientific Societies

Year	1880	1890	1900	1910	1920	1930	1940
American Association for the Advancement of Science			1	9	9	14	18
American Ceramic Society				3	4	6	7
American Chemical Society			1	1	3	10	7
American Concrete Institute				1	2	10	15
American Institute of Architects	1	1	1	2	2	6	-
American Institute of Electrical Engineers			2	9	7	20	23
American Institute of Mining and Metallurgical Engineers				3	5	5	8
American Physical Society			1	4	6	11	32
American Railway Engineering Association				1	3	9	9
American Society for Testing Materials			3	8	12	16	15
American Society of Civil Engineers		1	4	6	9	42	40
American Society of Mechanical Engineers			1	12	14	26	30
Illinois State Academy of Science				9	8	11	11
Illinois Society of Engineers		2	8	8	9	17	17
Society for the promotion of Engineering Education			11	35	42	52	65
Western Society of Engineers			2	6	8	5	8

Faculty Participation in Engineering Society Activities.-The following discussion taken from a publication entitled "Memorandum Concerning the Development of the Civil Engineering Department of the University of Illinois during the Period 1934 to 1942" prepared by Professor W. C. Huntington, is applicable to the entire staff of the College and is repeated here.

"Serving on the committees of technical societies is considered to be an important factor in the quality of the instruction, writing, and research done by members of the staff. It keeps them in touch with the developments. It promotes acquaintance with other engineers and gives them information concerning the work being done by the department.. Comments and criticisms of committee members on reports submitted by staff members contribute to the value of reports on research projects or other procedures followed in any study. The appointment of a staff member to a committee is a recognition by his associates that he is qualified to contribute to the work of the committee and is, therefore, a recognition of the work being carried on by the department.

"In order to serve on committees, it has been necessary for staff members to attend meetings of the societies. Their attendance at such meetings has been noteworthy. This has involved large expenditures for travelling expenses, which with rare exception, have been paid by the staff members because the University does not pay such expenses, even in cases where they present papers, and the societies do not often pay such expenses. Since most meetings are held at a considerable distance from Urbana, the cost of travel is especially large for members of this staff."

Many members of the staff have contributed regularly to the work of society or association committees assigned to the formulationof policies or the preparation of technical reports, while others have presented individual papers at society meetings or before technical clubs,-as a rule these reports and papers being normally published in the proceedings or professional journals of the organizations. In addition, many members have been signally honored by having been elected to official positions as administrative heads or as representatives on the boards of direction of their technical and scientific societies.

Special mention should be recorded here of the fact previously stated that Professor Ira O. Baker was the original sponsor and was one of the charter members of the Society for the Promotion of Engineering Education founded in Chicago in 1893. Special mention should also be made that Professor Baker was the original sponsor as well as a charter member of another organization, the Illinois Society of Engineers founded in Urbana in 1886, the membership of which is made up of engineers from all branches of the profession and maintains its headquarters in Urbana-Champaign. A

bronze plaque commemorating the founding was erected in the Engineering Library in 1936,-fifty years after the establishment of the Society..

Faculty Contributions to the Technical Press.-In addition to the 150 or more textbooks published by the members of the College faculty through commercial firms, the 351 bulletins, 48 circulars, and 31 reprints prepared by the staff and issued by the Engineering Experiment Station, all mentioned in previous chapters, and the contributions of the group to the journlas of their technical and scientific societies, discussed in the foregoing section, the members of the engineering staff have consistently contributed to the technical press, articles dealing with a wide range of subjects in the fields of engineering education, engineering research, and engineering practice.

E. CHANGES IN THE ENGINEERING STUDENT BODY

Relative Position in the University.-An easy and common method of measuring the importance of an educational institution is by the number of students enrolled in its classes. This process is essentially superficial and fails to give consideration to more significant factors, but it is the only simple method that gives numerical data.

A study of enrollment figures shows that the registration in the College of Engineering in terms of the total number of men in the University at Urbana, and also of the total number of students here, has been as follows:

In 1880,	26.1% of the men students;	19.4% of the total number
1890	55.1% " " " "	56.1% " " " "
1900	47..5%	35.3%
1910	53.4%	46.1%
1920	31.6%	24.1%
1930	24.8%	17.4%
1940	22.2%	16.1%

The enrollment of the College in 1880 was proportionatly low because the registration in the other colleges included a substantial number of preparatory students. The College of Engineering was the first one of the University to secure

any considerable enrollment of students of collegiate grade; and it was the first to obtain a high standing in comparison with other institutions of the country.

F. CHANGES IN ALUMNI STATUS

General.-Because most of the engineers in responsible positions in the 1870's were self-taught, and had attained their positions by progress through the ranks of practice, they were at least skeptical as to the possibility of any ones' learning in the technical school anything of value in engineering. As a result, for at least the first ten years of the history of the College of Engineering, its students and graduates learned from experience that it was not wise to disclose the fact that they had attended any college, much less an engineering school. By degrees, however, the value of a technical training began to be recognized by practicing engineers. Toward the end of the second decade, engineering-college graduates were sought, or at least received, because of this training; and in some cases they were advanced over men who had had more practical experience, but who had not received an engineering college education. Finally, toward the end of the third decade, the number of engineering graduates had so greatly increased and their qualifications had so much improved, that they began to dominate the profession. As a result of the improved status of the engineering graduates, the number of engineering-college students rapidly increased. The two world wars have demonstrated beyond doubt the value to industry of a sound training in engineering. Engineers have been placed in key positions and have not been found wanting in capacity to serve. Thus, little by little, the engineer by demonstrating his ability to perform useful service along professional and industrial lines, has earned a place in society that ranks on a par with that attained by members of other learned groups.

G. ACHIEVEMENTS OF THE COLLEGE OF ENGINEERING

General.-It is finally proposed to present here a short summary of the achivements of the College of Engineering as they relate both to experimental and educational fields. In the brief space allotted to this assignment, it is next to impossible to do anything more than to touch on a limited number of high spots in recording a summary of what has been accomplished by the College of Engineering during the

seventy-five year period of its existence. In such a summary, it is necessary to omit reference to any individual or departmental achievements or accomplishments and to present only general statements relating to the College as a whole.

Accomplishments in Engineering Research.-The portion of the funds allotted to the College from time to time spent for investigational purposes has provided means that have not only served to extend the borders of the systematic knowledge in the field of applied science, but also to return to the State and even to the Nation many-fold the amount of the investment in the form of increased production in industrial enterprise and the improvement of social conditions and domestic life. Although it is impossible in most cases to represent in terms of money, the value of the College's contributions in the field of research, it is a well-known fact that through its scientific investigations and scholarly research, the College has discovered facts and principles that are worth literally millions of dollars to the engineering industries, to say nothing of their value to human welfare generally. A prominent industrialist indicated that the results developed from one experimental project were worth "ten millions of dollars annually in the Chicago area alone".

Those contributions have been incorporated into plans for the production of engineering materials and building projects, and for the development of ceramic products, the motion-picture industry, and radio and other forms of communication; into methods of public-ulility operation, power production and utilization, industrial-plant operation, heating, ventilating, and air-conditioning, and public and domestic sanitation; and into designs of numerous other forms of industrial enterprise.

Accomplishments in Engineering Training.-The portions of the college income that have been invested for educational purposes in the training of the young men of the Commonwealth have provided instructional opportunities that might not have been available under other conditions. About 20 000 have received some share of their basic technical training in this institution. Of this total number, approximately one-half have completed the requirements of a four-year curriculum and have been granted degrees by their respective departments. The remainder have pursued courses

running through periods varying from one to six or seven or even more semesters in length. Most of these graduates and many of the non-graduates have found employment in some of the engineering industries that are so vital to the development of the State and Nation,-some of them in executive positions, others in professional practice, and still others in educational service,-and have directed their efforts to good advantage not only for a greater efficiency in service and their own advancement in earning power, but also for the greater upbuilding of the communities which they have chosen to serve. Indeed, the chief advantages of a college education are not to be defined in terms of money values, but in terms of ability to serve and to contribute towards those higher standards of moral and intellectual existence that transcend any rating formulated on financial merit or consideration.

H. THE FUTURE

General.-Notwithstanding its unpromising start, The University has acquired, during its astonishing rate of growth in the last seventy-five years, a momentum that will not permit any complacency on account of its scholastic attainments and achievements, but which will, with the greatly-increased interest in education in general, with its ever-widening fields of service to the people of the State, and with its steadily-increasing liberal financial support by the legislative body of the State, continue to inspire even greater progress and expansion in both the quality and quantity of usefulness, which will insure that the institution will continue to advance with the local community and the State of which it is such an important integral part.

Similarly, the College of Engineering, although started in a non-manufacturing community and in an environment that gave little promise and encouragement, has developed in increase in physical-plant facilities, in size and ability of staff, in scope of work and in numbers of students, until now its world-wide reputation for its efforts along instructional and experimental lines, will insure its continued prosperity. In addition, its relations to a great and growing university makes it doubly certain that it will reach still greater heights in achievements and usefulness. The College, however, must ever strive through its

day-by-day and year-by-year performance to maintain a position where it will be prepared to serve the citizenry of the State in facing the educational and industrial problems that may confront them in the contemporary experiences of each generation as it takes its turn in the eternal round of human activity.

INDEX

A

B

C

D

E

F

G

H

I

J

K

L

M

N

Q

R

T

V

Y

Z

A HISTORY OF THE COLLEGE OF ENGINEERING OF THE UNIVERSITY OF ILLINOIS 1868-1945

Part II

BY

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URBANA, ILLINOIS